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HANDBOOK

FOR THE

10-INCH B.L. GUN.



LONDON:

PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
BY HARRISON AND SONS, ST. MARTIN'S LANE,
PRINTERS IN ORDINARY TO HER MAJESTY.

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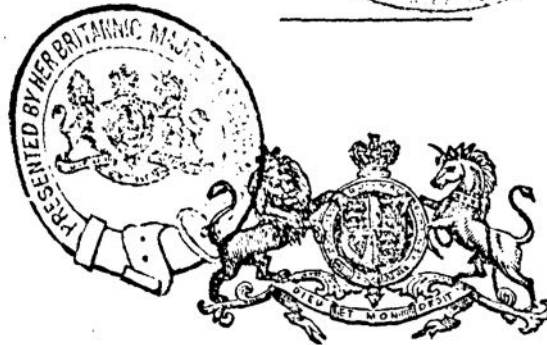
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CONTENTS.

	PAGE
Guns	3
Breech Mechanism	4
Sights	7
Instructions for care and preservation of Guns	8
Barbette Mountings	14
Care and preservation of Barbette Mountings	24
Disappearing Mountings	28
Instructions for erection, care, and preservation of Disappearing Mountings	48
Special appliances for Disappearing Mountings	51
Projectiles	54
Fuzes	59
Tubes	62
Tube Extractors	64
Instructions for Leclanché Battery	64
" " Menotti Test Battery	65
" " Battery and Key, test and firing	66
Range Tables	68
Drill	70
Instructions for using the Large Clinometer	98

	PLATES.

	PLATES
Guns	I and II
Breech Mechanisms	III and IV
Locks	VI to X
Barbette Mountings	XI to XVI
Disappearing Mountings	XVII to XXII
Special appliances for disappearing Mountings	XXIII to XXVI
Projectiles	XXVIII to XXIX
Fuzes	XXX
Cartridge	XXXI to XXXIV
Tubes and Tube Extractors	

This Handbook is corrected up to July, 1892. Any alterations which may be suggested should be forwarded to the Assistant to Director of Artillery, Woolwich.

10-inch B.L. Gun, Marks I, II, III.

DESCRIPTION

(Plates I and II.)

Material ..	..	..	..	Mk. I.	Mks. II and III.
Length ..	..	..	..	Steel	Steel
				342.4 in.	342.4 in.
Weight ..	{ of gun without fittings ..	..	..	{ 30 tons 16 cwt. 2 qrs. 12 lbs. }	{ 27 tons 16 cwt. 2 qrs. 2 lbs. }
	{ of breech fittings, including bronze frame, but without elevating band ..	..	..	{ 1 ton 3 cwt. 1 qr. 16 lbs. }	{ 1 ton 3 cwt. 1 qr. 26 lb. }
Bore ..	{ diameter ..	..	..	10 in.	10 in.
	{ length { to muzzle end of liner ..	..	..	317.5 in.	320 in.
Chamber ..	{ diameter ..	..	..	14 in.	14 in.
	{ length ..	..	..	54 in.	54 in.
Firing arrangement ..	..	..	..	percussion	{ electric and percussion }
	{ system ..	..	..	{ polygroove, hook section }	{ polygroove, hook section }
	{ length ..	..	..	259.68 in.	262.18 in.
Rifling ..	{ twist ..	..	..	all Marks	{ uniformly, increasing from 1 in 60 calibres at breech end of rifling to 1 in 30 at muzzle }
	{ grooves { number ..	..	..	..	40
		{ width ..	..	..	0.6 in.
		{ depth ..	..	..	0.06 in.
System of obturation ..	..	..	..	..	pad
Venting ..	..	..	..	..	axial

MARK I.

The gun is made entirely of steel, and consists of the "A" tube, over which are shrunk the breech piece, prolonged at the rear for the reception of the screw, the 1 B, 2 B and 3 B hoops, extending to the muzzle. Over the breech piece, and a portion of the 1 B hoop, are shrunk the jacket and trunnion, secured longitudinally by interlocking the former with the breech piece, and the latter with the breech piece and 1 B hoop. The 1 C hoop is shrunk over the 1 B hoop immediately in front of the trunnion.

The "A" tube is fitted with a steel liner, extending from the seat of obturator to 2.5 inches from the muzzle.

The liner is secured at the breech end by a steel bush, screwed into the breech piece.

(7953)

The chamber is cylindrical, terminating in front with a curved slope. A bronze frame for carrying the breech mechanism is attached to the breech end by fixing screws.

A band for attaching the elevating gear is shrunk over the jacket near the breech. The pattern of the band varies with the nature of mounting.

MARK II.

The gun is of steel, and consists of the Alpha tube, over which is shrunk the "A" tube, the Alpha tube being secured at the muzzle by a steel ring. Over the "A" tube are shrunk the breech piece, prolonged at the rear for the reception of the screw, the 1 B and 2 B hoops. Shrunk over the breech piece are the 1 C hoop and trunnion, interlocking longitudinally with the breech piece and 1 B hoop. The 2 C hoop is shrunk over the 1 B hoop, immediately in front of the trunnion; the jacket being shrunk over the 1 C hoop at the breech.

The "A" tube is fitted with a steel liner, extending from the seat of obturator to the Alpha tube, the liner being secured at the breech-end by a steel ring screwed into the "A" tube.

The gun is of the same total length as the 10-inch Mark I gun, but the trunnions are 8.1 inches nearer the breech end.

The chamber is cylindrical, terminating in front with a curved slope.

A bronze frame, for carrying the breech mechanism, is attached to the breech end by fixing screws.

MARK III.

This gun differs from the Mark II in construction only, and consists of the "A" tube, over which are shrunk the 1 B and 2 B tubes, extending from the front of the chamber to the muzzle. At the rear is shrunk the breech piece, partially overlapping the 1 B tube. In front of the breech piece, and over the 1 B and 2 B tubes, are shrunk the 2 C hoop and 3 C hoop. Around the breech piece and a portion of the 2 C hoop are shrunk the 1 C hoop and trunnion, interlocking longitudinally with the breech piece and 2 C hoop. The jacket is shrunk over the 1 C hoop at the breech; the D hoop being shrunk over the 2 C hoop, immediately in front of the trunnions.

BREECH MECHANISM.

(*Plates III and IV.*)

The breech is closed by a screw having five portions of the thread removed longitudinally each one-tenth of the circumference. The interior of the gun at the breech being prepared in a similar manner, admits of the screw, when the raised portions are placed opposite the smooth surfaces in the gun, being driven home and locked by the tenth of a turn.

To the outer face of the breech screw is fitted a bronze end plate furnished with a hinged cam lever, by means of which the screw is locked and unlocked.

The cam portion of this lever when the breech screw is locked falls into a recess in the carrier ring, and so prevents any movement of the breech screw during firing. On depressing the cam lever after the breech screw is unlocked, the cam acts upon the surface of the carrier ring, partially withdraws the screw together with the obturator.

A catch for holding the cam lever down, and a catch retaining ratchet lever, is provided.

The cam lever is held in its elevated position by a spring catch fitted to the left lug of the breech screw.

The lever may be partially lowered for the purpose of releasing the obturator by pushing the knob of the plunger in Mark I gun, or by depressing the lever of the catch in Mark II and III gun.

Encircling the rear end of the breech screw, and hinged to the bronze frame, is a carrier ring, which supports the screw when withdrawn. The ring is provided with bearing rollers to facilitate the movement of the breech screw, and to lessen friction at the hinge, a roller frame with seven coned rollers is fitted.

The carrier ring is held to the gun during the withdrawal of the breech screw by a clip, pivoted within the left side of the ring, engaging with a recess in the bronze frame.

A stop bolt in the right side of the carrier ring prevents the breech screw being disengaged from the carrier when withdrawn; at the same time the clip is disengaged from the recess in the bronze frame by means of a spring, which forces its opposite end into a recess in the breech screw, thus securing the latter in the carrier ring.

In closing the breech the lower arm of the clip is depressed by coming in contact with an inclined plane in the bronze frame, and the clip being pivoted, is consequently released from the recess in the screw, leaving it free to be pushed home. When the cam lever is elevated it engages a gudgeon projecting from a block sliding in a recess in the upper part of the bronze frame. To this block is attached a Stanhope lever, actuated by a ratchet lever, provided with a reversible double pawl, the arms of which gear by means of a spring pin with the teeth of the ratchet wheel. The ratchet lever pivots on a fixed axis on the upper left side of the breech, and in combination with the Stanhope lever, affords great mechanical power in turning the breech screw both in opening and closing the breech.

The double pawl is reversed automatically by means of a tappet attached to the ratchet wheel, which thereby changes the direction of motion round the axis. A small lever is fitted to the pawl for reversing it by hand, when desirable.

A rack is fitted to the right side of the breech screw. A pinion, which gears with the rack, is keyed to the hinge bolt. To the bolt is also attached, by means of a nut and keep pin, a worm-wheel, which gears with a worm and spindle fitted to the bronze frame. The whole is so arranged that in turning the spindle in one direction the screw is withdrawn from the breech opening into the carrier ring, and upon further action the ring, together with the screw, is carried into the loading position.

The reverse of this action takes place in closing the breech.

In the event of accident to the controlling gear, the breech screw may be withdrawn, and swung into its loading position by hand, the worm wheel having previously been removed from the hinge pin, and replaced by a distance piece, which is provided.

To retain the carrier ring open when required, a spring latch is provided, which can be put out of action by raising the small lever attached to it with Mark I guns, and in the case of the Mark II and III, is withdrawn by means of a lever pivoted on the under side of the carrier ring.

Obturation.

The system of obturation consists of a circular pad with protecting discs fitting the mouth of chamber, placed between the head of the axial vent and the breech screw.

The pad being slightly elastic expands radially when compressed by the action of the powder gas, thus sealing the escape.

Thin discs of steel are used to adjust the required thickness of the obturating pad.

FIRING MECHANISM.

The mechanism is so arranged that the gun cannot be fired until the screw is locked in the gun and the cam lever depressed.

MARK I GUN.

Percussion.

The gun is furnished with an axial vent, at the outer end of which is fitted a slide box, holding a percussion lock.

The percussion lock A consists of a frame, fitted with a hammer actuated by a main spring, a trigger, hammer guard, striker, and spring guide bolt. The hammer is held in its elevated position by the trigger. A lanyard bolt, having one side bevelled corresponding with the ends of the hammer guard and trigger, is fitted to the slide box. The hammer guard is furnished with projections on its upper surface for preventing the hammer coming in contact with the striker except when it is released by the lanyard bolt. When the lanyard bolt is pulled, the hammer guard and trigger are pressed, thereby releasing the hammer and at the same time moving the projections on the guard from under, and allowing it to fall on the striker. The guide bolt gears with a link attached to the cam lever.

The percussion lock is connected by a link to a groove in the cam lever, so that in depressing or raising the latter, when the breech is closed, the lock is moved to and from the firing position.

The lock is prevented from being in the firing position before the breech is properly closed, by a stop pin actuated by pivoted lever with a spring and piston. In turning the breech screw when opening the breech, the stop pin engages with a groove in the under surface of the lock. In closing the breech the pin is withdrawn from the groove by the lever moving up an incline on the carrier ring.

ELECTRIC.

MARKS II AND III GUNS.

(Plate V.)

The electric lock "B" is used; it consists of a steel frame, having a projecting arm, in which is an insulated contact, fitted to the lower end of which is a terminal point, over which one of the tube wires is placed, the other being connected to a return wire from the battery. The frame is furnished with a spring guide bolt engaging

with a link attached to the cam lever, by means of which the lock is brought down into the firing position when the cam lever is depressed. The lower portion of the frame is fitted with an extractor for removing the tube after firing. When the lock is raised, the wedge shaped extractor is forced under the head of the tube, thus releasing it from the vent. A lanyard is attached to the extractor.

Fitted to the upper lug of the bronze frame is a bracket with an insulated contact, to which the line wire is attached. The bracket and electric lock are so arranged that when the screw is home and the cam lever lowered, contact is made.

PERCUSSION.

Marks II and III Guns.

(Plate V.)

The percussion lock "D" consists of a frame fitted with a striker, cocking lever, trigger, and spring guide bolt. The striker is actuated by a spiral spring. The lock is attached to the cam lever in a similar manner to the electric lock "B," and so arranged that when the cam lever is raised, the striker is cocked automatically by the cocking lever, and maintained in its cocked position by the trigger. The trigger is fitted with two loops, to either of which the lanyard may be attached, one being for a horizontal pull to the rear, the other for a pull in an upward direction. The lower portion of the frame is fitted with an extractor similar to that described for the electric lock "B."

SIGHTS.

The gun is side sighted. The *foresights* are of the drop pattern, and consist of a pillar, jacket, and socket with a steel acorn screwed into the pillar. The socket is permanently fixed in a bracket attached to the gun, except in the case of Mark III guns of future manufacture, which will be furnished with sight rings. The pillar locks into the socket with a bayonet joint, and is secured from turning by a projection on the jacket, which drops into a recess in the socket when the sight is in its true position. The sight cannot be removed without first raising the jacket and turning the pillar round a quarter of a circle.

The *tangent sight* consists of a steel bar, triangular in section. On the muzzle face is a degree scale, and a rack which gears with the pinion in the automatic clamp. The rear faces are fitted with range strips graduated in yards for a full charge, and stamped with the corresponding M.V. The crosshead is fitted with a deflection leaf worked by a screw capable of giving 2 degrees deflection right and left. The leaf has a vertical sight blade of a height corresponding to about a mean length of 1,000 yards on the yard scale, and also a sight notch 0.06 inch deep. On the leaf is engraved a zero mark, and the deflection scale is engraved on the corresponding upper face of the crosshead.

The strips are graduated to 10,000 yards for a charge of 252 lb., giving a M.V. of 2,040 f.s., and due correction made for height of line of sight above the axis of the gun.

The sight blade is intended for use in conjunction with the elevation indicator, or other methods of giving quadrant elevation, elevation being given by means of the latter, and line only by the

sights. When using the sight blade the sight should be clamped about 1,000 yards less than the estimated range of the ship, if the ship is approaching, and at the estimated range, if the ship is going away, as by this means the gun can be laid for line at any time during the period the ship takes to move 1,000 yards. The notch is for use when elevation and line are both to be obtained by means of the sights.

CARE AND PRESERVATION OF GUN AND FITTINGS.

The guns should be examined after firing every 50 rounds with projectiles.

The bores of guns from which practice is carried on should be kept slightly oiled, to prevent rusting. At the close of each day's practice they should accordingly be washed, and slightly depressed, and when dry oiled with a sponge; the muzzles being then closed with tampeons.*

When guns are not likely to be used for some length of time, the sights, locks, and smaller fittings should be removed, and kept in store, the holes in the guns being filled with a plug of greased tow, to keep out water and dirt. These plugs can be readily removed when it is required to fit the sights, &c., to the guns, and particular attention should be paid to the prevention of rust or grit accumulating in the sight recesses, &c.

The sights and other fittings should be kept clean, free from grit, and oiled; the sliding leaf of the tangent sights, as well as the jackets of the fore sights, should have free play.

The exposed portions of the sights are bronzed if made of gun-metal, and blued if of steel. This is done to preserve them from corrosion, and on no account are these parts to be burnished or cleaned in such a manner as to remove the bronzing or bluing.

The bore and all working parts must at all times be kept slightly oiled, and perfectly free from rust.

During firing the breech screw and breech opening must be kept perfectly clean, free from dirt, and well greased with a mixture of oil and tallow. It will be found convenient, although not absolutely necessary, if the number in charge of the breech screw runs over these surfaces with a piece of oily waste after each round.

The officer in charge of the gun must always see that the safety gear is in good working order, and that the cam lever is in its proper position before firing.

Instructions for the care of the De Bange Pad Obturator.

Keep the pad well greased, and before firing take it off the stalk, if possible, and grease it all round. If a pad becomes very hard, soak it in a hot mixture of oil and tallow.

During practice wash the breech-screw and pad frequently with soft soap and water.

Should a pad get too soft from rapid firing, remove it and place it in cold water.

After firing, place the pad in cold water.

Causes which lead to stiffness in working the breech —

1. Pad not in good order;
2. Too many adjusting discs behind the pad.

* An expanding tampeon with jointed stave, to be inserted through the breech, is under consideration for this gun.

FITTINGS.

The following is a list of the component and spare parts issued with each Gun.

3

Designation.	Detail.	No. per Gun.		Proportion of spare allowed	
		Mark I.	Marks II, III.	Per Gun.	To No. of Guns or less.
Bolt, stop	Steel, for breech screw	1	1	..	1 to 10
Box, slide	Steel, in halves, with two keys, two keep pins, lanyard bolt, nut, and spring ..	1	..	..	1 to 10
"	Steel, in two parts .. ..	..	1	..	1 to 10
Contact, electric, frame, fixed	Aluminium bronze, with insulating bush and washer; washer, case, retaining nut, and fixing screw and lead .. ..	..	..	1	..
Cover, lead	Bronze, with three fixing screws .. ..	..	..	..	..
Contact, lock, electric, "B"	Aluminium bronze, consisting of block with two terminal points, insulating bush and washer; washer, and retaining nut and lead; contact, upper, with insulating bush and washer, case, nut, and spiral spring .. ..	..	..	..	..
Discs, pad, { adjusting	Steel	2	2	6	..
obturating { protecting	Tin, two to a set, front and rear	1	1	5	..
Extractor, lock, electric, "B"	Steel, with axis pin, spiral springs, and lanyard, also lock, percussion, "D" ..	..	..	4	..
Lever, ratchet, breech screw	Steel (locking and unlocking), with removable plate and three fixing screws, axis pin, washer, and keep pin; ratchet wheel, with tappet and fixing screw; pawl with axis pin, handle, pin directing pawl, with spiral spring; link for ratchet, link for sliding block, with hinge bolt and sliding block, with gudgeon, and catch, retaining, ratchet lever	1	1	2 for each lock	..
Lever, cam	Steel, with hinge, bolt, nut, and keep pin	1	..	..	1 to 10
		..	..	..	1 to 10

FITTINGS—continued.

10

Designation.	Detail.	No. per Gun.		Proportion of spare allowed	
		Mark I.	Marks II, III.	Per Gun.	To No. of Guns or less.
Lever, cocking, lock, percussion, "D"	Steel, with axis pin .. .. .	..	a	2	1 to 5
Lever, spindle, worn	Steel, mechanism, controlling, breech screw	1	a	..	
Lock, percussion, "A"	Steel, consisting of lock, frame, hammer, hinge pin, and flat spring; trigger, axis pin, flat spring, and fixing screw; trigger guard and fixing screw; hammer guard, flat spring, and fixing screw; striker, spiral spring, securing nut and set screw; guide bolt, spiral spring, head, and keep pin	1	..	1	
Lanyard bolt	Steel, with spiral spring and nut	a	..	1	
Lock, electric, "B"	Steel (for wired tubes), consisting of frame, block with two terminal points, insulating bush and washer; washer and retaining nut, lead and retaining cap; contact, upper, insulating bush and washer; washer, case, and nut. spiral spring and cap, retaining, contact, cover for lead; guide bolt with spiral spring, handle and keep pin; extractor, with axis pin, spiral spring, and lanyard .. ..	..	1	1	
Lock, percussion, "D"	Steel, consisting of frame, striker with firing pin, spindle, keep pin, and spiral spring and retaining cap; cocking lever with axis pin; trigger with axis pin and spiral spring; guide bolt with spiral spring, handle, and keep pin; extractor, with axis pin, spiral spring, and lanyard .. ..	..	1	1	
Pad, obturating	Asbestos, canvas, covered, annular .. ..	..	1	1	
Pinion, rack	Steel, mechanism controlling, breech screw	1	1	3	
Pin, firing, lock, percussion, "D"	Steel .. ..	..	a	..	1 to 10
		..	a	10	

[illegible]

SIGHTING APPURTENANCES.									
Clamp, tangent sight, automatic, "C"	Bronze..	..	..	..	..	..	2	2	..
Sight, B.L. { fore ..	"	..	..	..	..	..	2	2	..
tangent ..	Steel, with removable range strips, two to a set	..	..	..	..	..	2	2	1 to 5 1 to 5
IMPLEMENTS.									
Bit, vent, 36-inch	Steel	..	..	..	..	..	1	1	1†
Bolt, eye, breech screw	Steel, slinging, breech screw..	..	..	..	..	..	1	1	1 to 5
Extractor tube { P ..	Steel, vent sealing tube	..	..	..	..	..	1	1	3 to 2
.. { P, special	" V.M. and P...	..	..	..	..	..	1	1	1 to 2
.. { P, special	Steel	..	..	..	..	..	1	1	1 to 5
.. { P, special	Steel, with lengthening piece	..	..	..	..	..	1	1	1 to 5
.. { P, special	Steel, lock, percussion, A	..	..	..	..	..	1	1	1 to 5
.. { P, special	Steel, for electric and percussion locks	..	..	..	..	..	1	1	1 to 5
.. { P, special	Steel, axial vent	..	..	..	..	..	1	1	1 to 5
.. { P, special	Steel, six wrenches, A, B, C, D, E, F, and tommy	..	..	..	..	..	1	1	1 to 5
.. { P, special	Steel, six wrenches, A, B, C, D, E, F, and tommy	..	..	..	..	..	1	1	1 to 5

NOTE.—"a" denotes articles issued spare, but also included elsewhere in the detail column of this list.

* A few guns only are fitted thus. † Per work.

MOUNTINGS.

Carriage, Garrison, Barbette, B.L., Mark I, Slide, "L," Barbette, Mark I.

Carriage, Garrison, Barbette, B.L., Mark II, Slide, "L," Barbette, Mark II.

Carriage, Garrison, Barbette, B.L., Mark, III, Slide "L," Barbette, Mark III.

Carriage, Garrison, Disappearing, B.L., Mark I.

Carriage, Garrison, Disappearing, B.L., Mark II.

Carriage, Garrison, Disappearing, B.L., Mark III.

CARRIAGE, GARRISON, BARBETTE, B.L., 10-INCH,
MARK I. SLIDE, L, BARBETTE, B.L., 10-INCH, "C,"
MARK I.

CARRIAGE.

(Plate VI.)

The carriage is on the hydraulic system, and is mounted on rollers. It is made of steel, and fitted with two hydraulic buffers, connected by a pipe in front to equalise the pressure; two gunmetal bearings for the gun trunnions; a steel shield;* frictional elevating gear; and four steel clips at the front, and two in rear, which engage flanges on the slide, and prevent the carriage from lifting.

The carriage when mounted admits of 15 degrees elevation, and 6½ degrees depression.

SLIDE L. C PIVOT.

(Plate VI.)

The slide is of steel, and revolves about a centre pivot. The pivot plate consists of a cross girder carrying a brass bush, and is fixed to the underside of the slide. The pivot passes through the bush. The slide is fitted with two front and two rear trucks; traversing gear; retaining gear for holding the carriage in loading position; loading and sighting platforms,† and a loading derrick.

Clips are fitted on the front truck brackets, which engage a flange on the pivot plate, to prevent the mounting from lifting.

A graduated arc E is let into the floor of the work, and a pointer F is fixed to the rear of the slide, by which the angle of traverse is indicated.

The firing key, with electric battery, is supplied to be placed at G or G¹, according as the laying is by the gun sights, or by the elevation indicator and graduated arc. The battery remains at G¹, the key only being shifted.‡

* The latest pattern is straight instead of curved as shown in the drawing.

† The loading platforms of Slides No. 3545 and 3546 are 4' 1" long; those on the other slides are 5' 3".

‡ With the mountings issued to Singapore the battery and key are distinct, and somewhat different from the Service pattern. The lower position of the key must be determined locally so as to clear the elevating wheel. Studs for fixing are supplied. The training pointers will be fitted locally.

HYDRAULIC BUFFER.

(Plate VII.)

The cylinders A are of forged steel, and are fixed to, and recoil with, the carriage. The piston rods B pass through the front of the cylinder, and are attached to the front of the slide. They are fitted at the rear with pistons, containing a rotating valve C. The cylinders are fitted with a filling plug D, and a drain plug E.

Controlling rams EE are fitted to the rear cap of the cylinders.

PISTON VALVE.

The pistons are fitted with a gunmetal rotating valve C, with two ribs (H), which fit into rifled grooves L, in the cylinders. Ports (J) are cut in the pistons, and corresponding ports K are cut in the valves.

FILLING THE CYLINDERS.

With the carriage in firing position, remove the plugs D from the cylinders (Plate VII), and from the tank L. Pour the fluid into the tank and pump it into the cylinders till it overflows at the plugs D. Replace the plugs D, and pour the remainder of the fluid into the tank, and the carriage is ready for firing.

On the left front of the carriage is a small bronze handwheel. This opens or closes a passage from the tank to the buffers.

The instructions for its use are:—

Open.—To run up.

Close.—Before firing, or to pump back.

The motion to close is in the same direction as the hands of a watch.

The quantity of liquid required is about $18\frac{1}{2}$ gallons.

The liquid for use in the recoil cylinder is rangoon oil. Any pure oil will, however, answer, or, failing oil, distilled water, or a mixture of glycerine and distilled water.

ACTION OF HYDRAULIC BUFFER.

When the carriage is in the firing position, the port is full open. As the carriage recoils, the valve C is rotated by the ribs H sliding in the rifled grooves L in the cylinder, thus gradually closing the port, until it is completely closed, when the carriage is at extreme recoil. The resistance thus offered to the passage of the liquid through the port is sufficient to overcome the energy of recoil in a length of travel of 54 inches. The pitch of rifling and the form of the openings are so arranged that the velocity of the liquid through the port is the same at any position, thus causing a uniform pressure in the cylinder during recoil, and reducing to a minimum the strain upon the pivot and foundations.

As the carriage returns into the firing position, the controlling ram EE enters the hole in the rear end of the piston rod, and displaces the liquid which has passed into the hole when the carriage was at extreme recoil. The clearance between the ram and the hole is so small that a considerable resistance is offered to the motion of the gun and carriage, and thus they are prevented from running out violently against the front buffers of the slide.

RUNNING BACK PUMP.

The running back pump is *for drill purposes only*. The bye pass valve, worked from the wheel near the pump handles, must be closed before commencing to pump the carriage back, and opened to run it up. Before firing particular care must be taken to close this valve to prevent the air which gets into the hydraulic buffers being forced into the tank on running up, and so causing an overflow. If the carriage does not run up completely owing to air in the buffers, this valve should be opened to release the air gently, and closed again before firing.

The pump (in the tank L, Plate VII) is worked by the handles M, which, by means of a crank acting on the plungers, force the liquid into the hydraulic buffers through the pipe P when the valve N is open, and the pressure acting upon the piston, runs the carriage back; when the carriage runs up, the liquid is forced back again from the hydraulic buffer into the tank.

TRAVERSING GEAR.

(Plate VI.)

The traversing gear is in duplicate, fitted on both sides of the slide, and connected to the front rollers. Handles are shipped on to the first motion spindles of the gear, and the rotation of these is communicated to the front trucks.

RETAINING GEAR (FOR HOLDING THE CARRIAGE BACK IN LOADING POSITION).

(Plate VI.)

An automatic retaining catch R is fitted on the right side of the slide for holding the carriage in loading position; it catches against the front edge of the holding down clip. On lifting the lever S, the carriage is released, and will run out.

Some carriages have been made with the holding down clip in two parts; when this is the case, care must be taken, when running up, to hold down the running up lever until the clips have both cleared the catch.

ELEVATING GEAR.

(Plates VI and VII.)

The elevating gear is fitted on the right side of the carriage, and consists of toothed gear, actuated by a handwheel A.

The handwheel is fixed on the spindle E, which is carried by a brass casing which covers the gear, and has a pinion formed on it. This pinion engages the spurwheel D, which is carried on the spindle C, and is free to rotate on it. On the inner extremity is fixed a pinion B, which engages the arc on the gun. The gear is provided with a compressor friction clamp, which acts in the following manner:—The steel friction rings are attached to and rotate with the spindle C. They engage alternately similar rings of gunmetal, which are keyed to, and rotate with, the spur wheel D.

These rings are pressed together by the nut I. The pressure on the spring disc H is adjusted by the nut I, so that the friction between the rings is sufficient to elevate or depress the gun, but will allow the gun to move without giving motion to the whole of the

gear when any great strain comes on it, such as occurs when the gun is fired.

The angle of elevation is indicated by a disc (Plate VI) keyed to a small pinion spindle, which is actuated by a toothed piece fixed to the elevating arc.*

TO ADJUST THE FRICTION OF ELEVATING GEAR.

Slacken the nut I, then screw it up gently against the disc H until the gun just moves when the hand wheel A is turned. Great care should be taken not to tighten the clamp more than necessary.

Before the gun is mounted, the paint must be scraped off the trunnion arms, and burrs, if any, removed, to ensure its turning freely in the trunnion bearings, and consequently the easier working of the elevating gear.

MOUNTING THE SLIDE.

The slide (with clips removed) must be carefully lowered on to the roller path, care being taken that it is directly over the pivot, so that the pivot pin enters the bush fairly. The nut must then be screwed on to the pivot pin, and secured by the cotter pin, and the clips replaced.

MOUNTING THE CARRIAGE.

Remove the front and rear clips from the inside of the carriage, and draw the outside front clips out to clear the flange on the slide. Then lower the carriage (with piston rods) gently on to the slide, bolt on the clips, and secure the piston rod ends to the brackets on the slide.

PIVOT AND RACER.

This consists of a heavy conical casting fitted with a pivot pin and truck path firmly bedded and bolted in concrete.

The extreme radius of the truck path for the C pivot is 74.6 inches, and both front and rear trucks revolve on the path. With the D pivot the radius is 46.65 inches, and only the rear trucks ride on the path, the front trucks travelling on a separate racer.

None of the weight of the mounting is taken by the pivot, the underside of the bush in the pivot plate of the slide being clear of the top of the pivot.

WEIGHTS.

	C pivot.		D pivot.	
	tons	cwts.	tons	cwts.
Carriage	8	2½	7	18
Shield and stays	3	6	3	6
Slide	9	11¼	10	9.5
Loading crane... ..	0	2	0	2
Pivot piece and pin	9	9.5	6	1
Holding down bolts, and anchor plates for ditto	0	19.75	2	6
Racers and joint plates	—	—	2	1.25
Anchor plates for ditto	—	—	1	3.25
Total	31	11	33	7

* The elevation indicators for the Singapore mountings will be fitted locally. (7953)

CARRIAGE, GARRISON, BARBETTE, B.L. 10-INCH, MARK II.
SLIDE, L, BARBETTE, B.L. 10-INCH, MARK II.

CARRIAGE.

(Plates VIII and IX.)

These mountings are constructed to fire "en barbette" over an 8 feet parapet, with 17 degrees elevation or 5 degrees depression; and to allow a recoil of 8 feet.

The carriage is fitted with two hydraulic buffers in tension to control recoil, and with fourteen rollers to ensure it automatically "running up" immediately after firing. Provision is also made for running the carriage back by means of a pump, which is used for drill purposes only.

The slide is fitted with suitable gear for traversing and elevating the gun; and with stop brackets, which transfer the shock of recoil to the front of the racer.

The carriage consists of two cast steel bracket sides, connected by a transom of similar material, to which they are fixed by dovetailed joints and steel bolts.

The brackets are each cast with ribs to increase the strength; with deep trunnion bearings to dispense with capsquares; and with pockets for the rollers.

Each bracket is bored out to take a steel cylinder for the hydraulic buffer, which is closed at each end with a steel cap. The front cap is fitted with a steel stuffing box, and with a metal gland for tightening the packing round the piston rod.

The buffers are designed to give an approximately constant pressure during recoil.

For this purpose they are fitted with taper bars, and apertures in the pistons, which can be altered in area by turning the piston rods; the resistance of the buffers is thus adjusted to suit varying charges.

The piston rods are turned by means of a connecting bar which is attached to their front ends by short levers, and a graduated scale is fitted on the front of the slide to indicate the amount of adjustment.

The cylinders are connected by a copper tube so that the quantity of fluid will always be the same in each buffer, to ensure equal pressure in both. A phosphor-bronze plunger is fixed to the rear cap and enters a cylindrical hole in the piston rod. The hole being slightly larger than the plunger, the arrangement acts like a small hydraulic buffer, to prevent violent concussion when running up.

The rollers are of steel, bushed with phosphor bronze, and revolve on steel axles, which are kept in position by iron plates (a), screwed to the carriage sides. Eight rollers, two at each corner of the carriage, are flanged on the inner side to serve as guides to the carriage. By removing the plates (a) the axles and rollers can be taken out for cleaning, &c., without lifting the carriage.

Rear clips cast on the inner side of the bracket sides, and steel front clips bolted on at (b), keep the carriage on the slide when firing.

The running back gear consists of a double acting pump in a cast iron cistern (*m*), connected to the buffer by means of a copper pipe, coupled to the hole for the right filling plug; the pump is hung on the right carriage bracket by two iron clip hooks, and is worked from the ground by means of a double handled lever (*q*), with stop to regulate the length of the stroke. The releasing valve is worked from the bottom of the cistern by a hand wheel, and a draw-off cock is provided for emptying the cistern. A portable derrick, with chain block, is fitted to the top of carriage bracket, for attaching and removing the pump.

SLIDE.

The slide consists of two girders connected by five cast steel transoms. Each girder is built up by rivetting iron plates on both sides of a top bar of T steel, and a bottom one of T iron.

The front end is supported on a casting of steel (*c*), which forms a transom with brackets (*d*) for the front trucks. The rear end rests on a supporting frame (*e*), which is hinged to the rear transom at (*f*), and to a steel casting at (*g*). The casting (*g*) is formed with brackets for the rear trucks, and is kept on the racer by two channel iron bars (*h*) fixed to a band (*i*) which works in a groove round the pivot block. The stop bracket (*k*) is fixed to the front casting (*c*) and projects downwards in front of the racer, to prevent the trucks leaving the track. Two horizontal rollers are fitted to the rear of the casting (*c*), and four rollers to the front to bear against the racer and reduce the friction when traversing. Two heavy cast iron blocks are fixed to the rear end of the slide to bring the centre of gravity of the gun and mounting approximately over the top of the pivot.

The elevating gear consists of a cross shaft with a sprocket wheel which is turned by the handwheels (*l*) and, by means of a sprocket chain, puts in motion a combination of spur gearing terminating with the pinion (*m*). This pinion (*m*) gears into the arc (*n*), which is pivoted by the elevating bar (*o*) to the fourth transom.

The elevating bar (*o*) is formed by connecting two parallel plates, which act as a sliding guide for a block fixed by a bracket and band to the breech of the gun.

A certain amount of slip is allowed to the elevating gear, by means of a cone on one of the spur wheels, which fits into a corresponding recess or socket, keyed on the elevating spindle. The cone is forced into the socket by a steel spiral spring coiled round the spindle, and contained in a metal sleeve. This sleeve is fitted with a nut for adjusting the pressure of the spring, the reaction of which is taken on another nut on the end of the spindle.

The amount of elevation and depression in degrees, and the range in yards, is shown by the indicator (*u*).

Traversing is effected by a cross shaft with bevel pinion, transmitting motion from the winch handles (*r*) to a longitudinal shaft fitted with two sprocket pinions on its end. These pinions convey power by two chains to two sprocket wheels keyed on two parallel shafts, which are also fitted with bevel pinions. These pinions actuate bevel wheels on two oblique shafts fitted with spur pinions, which gear into teeth on the trucks (*s*).

A hydraulic pivot is fitted to take the greater part of the weight off the trucks in order to decrease the work in traversing. It consists of a cylinder and ram fixed on the top of the pivot block. The ram presses upwards against a block fitted into the centre transom; the liquid is passed into the cylinder through the top of the ram by a pipe leading from a pump fitted to the centre transom. This pump has two rams, one arranged to be worked from the hand lever, and the other from the winch handle shaft of the traversing gear; the slide is raised by means of the hand lever, and kept up during traversing by the action of the eccentric fitted to the winch handle shaft. The lift is regulated by links connecting a releasing spindle to the pivot band; this spindle lifts the suction valve when the slide is at the required height, which is shown by a pointer which forms part of the regulating gear. The lifting ram is not provided with packing leathers; any liquid which overflows while the pump is being used runs into a circular tray, from which it passes into a tank to which the suction pipe of the pump is coupled.

The slide is fitted with front and rear buffer stops (*y*) composed of steel disc springs; also with suitable wood platforms at the rear, with ladders and hand rail attached, for loading and firing the gun.

A derrick (*t*) is attached to the slide for loading at any angle of elevation up to 17 degrees. The projectile is raised by a steel wire rope, which passes over sheaves fitted to the derrick; this rope is wound on a drum at the foot of the derrick; a shaft passes through the drum to take a winch handle; on the same shaft is carried a brake drum, connected to the rope drum by a ratchet wheel and pawl. The projectile can be lowered from the loading platform by means of a rod (*j*) attached to a lever (*p*), connected to the strap (*w*) of the brake drum. A pointer is fixed by a metal bracket to the centre of the rear casting (*g*) to indicate the angle of traverse, on a graduated arc let into the concrete.

The slide is arranged to take a compound armour shield if required. The pivot block is in one casting of iron, formed with a groove for the band (*i*). The top is fitted to take the cylinder for the hydraulic pivot gear; the upper part of this cylinder is made rectangular, and slides in a hole of similar shape in the block fitted to the inside of the centre transom.

The racer is of steel, cast in eight segments, with a hook on its outer circumference which takes the shock of recoil transmitted through the clip brackets.

					ft.	in.
Height of carriages (centre of trunnions)	..	..	..	..	3	0
" slide	..	..	..	..	6	8.46
Length of carriage	..	..	..	..	10	6
slide..	..	..	..	..	22	11.25
Diameter of racer	..	..	..	..	21	8
Height of pivot block	..	..	..	..	4	10.584

WEIGHT.

Carriage	..	..	..	..	11.75 tons
Slide	..	..	..	..	45.5 "

CARRIAGE, GARRISON, BARBETTE, B.L. 10-INCH,
MARK III, STEEL. SLIDE, L., BARBETTE, B.L.
10-INCH, MARK III, STEEL.

(Plate X.)

MOUNTING.

These mountings are constructed to fire "on barbette" over an 8 feet parapet, with 15 degrees elevation and 5 degrees depression, and to allow a recoil of 8 feet.

The carriage is fitted with two hydraulic buffers, with rods in tension to control recoil, and with ten rollers to ensure its automatically running up immediately after firing. Provision is also made for running the carriage back by means of a pump, which is used for drill purposes only.

The slide is fitted with suitable gear for training and elevating the gun, and with stop brackets, which transfer the shock of the recoil to the front of the racer. The mounting is traversed round a central hydraulic pivot by four men working on winch handles.

CARRIAGE.

The carriage consists of two cast iron brackets, with a steel plate on each side, the inner plates being deep enough to form a well in which are fitted the hydraulic buffers. The brackets are connected by three plate and angle transoms and a bottom plate. The trunnion bearings have a deep "sink" to dispense with capsquares.

The buffers are designed to give an approximately constant pressure during recoil, by having the bore of the cylinders slightly tapered for about two-thirds of their length, so that the clearance space between the piston and cylinder may form a varying orifice for the flow of the liquid.

The cylinders are connected by a copper tube to equalise the quantity of liquid in each buffer, and preserve an equal pressure in both. A phosphor bronze plunger is fixed to the rear cap, and enters a cylindrical hole in the piston rod when the carriage runs out; the hole being only slightly larger than the plunger, obstructs the escape of the liquid contained in it, and serves as a small hydraulic buffer to prevent violent concussion when running up.

The rollers are of steel, bushed with phosphor bronze, and revolve on steel axles, which are kept in position by iron plates screwed to the carriage sides. By removing the plates the axles and rollers can be readily removed for cleaning, &c., without lifting the carriage.

Rear clips (*s*) bolted on the inner side of the bracket, and front clips (*t*) bolted on the outer side, keep the carriage on the slide when firing.

The elevating gear is constructed as follows: A longitudinal shaft (*u*), fitted to the right side of the slide, is rotated by a hand wheel (*a*) by means of a cross spindle and mitre wheels, a sliding pinion (*w*) which works a vertical worm shaft (*x*) and worm wheel (*y*) attached to the carriage. The spindle of the worm wheel has a pinion which gears into the elevating arc (*b*), fixed by a band to the gun. A

certain amount of slip is allowed to the elevating gear by means of a cone fixed on the worm wheel spindle, and which fits into a corresponding recess in the worm wheel. The cone is forced into the recess by a steel disc spring, which can be adjusted on the spindle to regulate the amount of slip. The elevation and depression in degrees, and the range in yards, are shown by the indicator A.

The running back gear consists of a double acting pump in a cast iron cistern (B), connected to the buffers by a copper pipe, coupled to the hole for the right filling plug. The pump is hung on the right side of the carriage by two brackets, and secured with keys. It is worked from the ground by means of a double handled lever (D), with a stop to regulate the length of the stroke. The releasing valve is worked from the bottom of the cistern by a hand wheel; and a draw off cock is provided for emptying the cistern. A portable derrick (v), with chain block, is fitted to the top of the carriage bracket for attaching and removing the pump.

SLIDE.

The slide, which is constructed to traverse on front and rear trucks round a central hydraulic pivot, consists of two girders connected by five transoms, each girder being built up by rivetting iron plates on both sides of a top and bottom bar of T iron, with a steel plate on the top bar.

The front of the slide is supported on a box transom built up of steel plates and angles, and having a cast steel plate on the bottom, with stop brackets projecting downwards in front of the racer to prevent the trucks leaving the track; two horizontal rollers (E) are fitted to the rear of the casting, and four rollers (F) to the front, to bear up against the racer and reduce the friction when traversing. Brackets are fitted inside the box transom for taking the truck axles.

The rear end of the slide is hinged to the cast iron supporting blocks at (C); the supporting blocks are hinged at the bottom to a carriage (H), in which the rear trucks are fitted; and this carriage is kept on the racer by two channel iron bars, fixed to a band (r), which works in a groove round the pivot block. The weight of the supporting blocks is augmented by two cast iron counterweight blocks placed on the top of them, in order to bring the centre of gravity of the gun and mounting approximately over the hydraulic pivot.

Traversing is effected as follows: A cross shaft and bevel wheels (J) transmit motion from the winch handles (K) to a short oblique shaft (L), fitted with a pinion on its lower end; this pinion actuates bevel wheels on two radial shafts (M), which have upon their front ends the front trucks of the slide.

The hydraulic pivot is arranged to take the greater part of the weight off the trucks, in order to decrease the work in traversing. It consists of a cylinder and ram fixed on the top of the pivot block. The ram is pressed upwards against a heavy steel plate (N), fitted between the centre transoms, by the liquid being forced through the pipe (P) and the ram into the cylinder, by a pump fitted to the centre transom. This pump has two plungers, worked from the winch handle shaft of the traversing gear by eccentrics, which are so arranged that their position on the shaft relatively to each other can be adjusted so as to give a differential action to the two

plungers. One of these, by means of a gab (R) on its eccentric rod, can be disconnected from the traversing gear, and worked by the hand lever (d). The slide is first raised by this method, and afterwards kept up during traversing by the action of one or both of the eccentrics fitted to the winch handle shaft. The lift is regulated by the links (e) connecting the releasing spindle to the pivot band; this spindle (f) lifts the suction valve when the slide is at the required height, which is shown by a pointer (g), which forms part of the regulating gear. The lifting ram has no packing leathers; any liquid which overflows while the pump is being used runs into a circular tray, and passes thence into a tank, from which it is again drawn by the pump.

The slide is fitted with front and rear buffer stops (T), composed of steel disc springs, and with suitable loading platforms at the rear, with ladders and hand rail attached.

A derrick (h) is attached to the slide for loading at any angle of elevation up to 15 degrees. The projectile is raised by a steel wire rope, which passes over sheaves fitted to the derrick, and is wound on a drum (i), worked by a winch handle at the foot of the derrick. The shaft passing through this drum also carries a brake drum (k), connected to the rope drum (i) by a ratchet wheel and pawls. The projectile can be lowered from the loading platform by means of a rod (l) attached to a lever (m), connected to the strap (n) of the brake drum (k).*

A pointer (Q) is fixed to the centre of the rear truck carriage, to indicate the angle of traverse on a graduated arc let into the concrete floor.

The pivot block is in one casting of iron, and is rigidly connected to the racer by eight cast iron arms; a groove is formed in the pivot block to take the band (r), and the top is bored out to take the cylinder for the hydraulic pivot gear. The under part of the metal pivot bush is made square, and slides in a rectangular hole in the centre transom. An angle iron ring in halves rests on the racer arms round the pivot block, to retain the concrete round the recess for the bevel wheels of the traversing gear.

The racer is of steel, in eight segments, and is securely bolted to the outer ends of the supporting arms.

				ft.	ins.
Height of carriage (centre of trunnion)	..	..	..	4	0
" slide .. .. .	..	..	..	5	4 843
Length of carriage .. .. .	..	..	..	9	6
" slide .. .. .	..	..	..	22	5.155
Diameter of racer .. .. .	..	..	..	21	8
Height of pivot block .. .. .	..	..	..	5	11.25
Weights—					
Carriage .. .. .	..	..	..	143	2
Slide, L. .. .. .	..	..	..	836	2

* Some mountings have been issued with a cartridge derrock in addition.

CARE AND PRESERVATION OF BARBETTE MOUNTINGS.

MARK I MOUNTING.

In order to preserve the mounting in working condition, the axles, spindles, shafts, pinions, and all bearings should be kept clear of clotted oil and rust, and be well lubricated. When not required for immediate use, the elevating arc, &c., should be coated with a mixture of white lead and tallow. The hydraulic buffers should be kept filled with oil to prevent rust in the internal parts, and the exposed portions of the piston rods covered with a mixture of white lead and tallow, to prevent them from rusting.

Before firing, the buffers should be examined to see that they are full. The piston rods and all working parts should be cleaned and oiled.

To renew the packing:—Run the carriage back about 2 feet and block it up. Empty the buffer by removing the plug on the under side. Unscrew the gland and slip it along the piston rod, to admit of the defective packing being extracted and replaced by the new, which must be well saturated with Russian tallow before insertion.

If the leather packing requires renewal, it will be necessary to disconnect the piston rods from the slide before running back. To do this take out the pin R (Plate VII) connecting the crosshead to the slide, run the carriage back, remove the securing pin S (Plate VII), and unscrew the crosshead from the piston rod to admit of the new leather being inserted in the box. The new leathers must be thoroughly greased, and carefully placed upon the rods so as not to damage the edges, and well pressed home by the metal ring before inserting the cotton packing.

MARK II MOUNTING.

All bright parts must be kept clean, and slightly greased. All working parts must be properly lubricated by means of the holes drilled for the purpose; care must be taken to replace the covering screws after lubrication.

If the carriage rollers become clogged with clotted grease and dirt they must be removed and cleaned. For this purpose the keeping plates must be removed and the axles withdrawn. The front and rear rollers must be rolled out, the remaining rollers being lifted out.

If the buffer leaks at the gland, the latter must be tightened up. If this will not stop it, the packing must be renewed.

To renew the packing:—Run the carriage back about 2 feet, and block it up. Empty the buffer by removing the run off plug on the under side. Unscrew the gland and slip it along the piston rod to admit of the defective packing being extracted and replaced by the new, which must be well saturated with Russian tallow before insertion.

If the leather packing requires renewal, it will be necessary to disconnect the piston rods from the slide before running back the carriage. To do this, take out the securing pins in the front nuts on the piston rods, and remove these nuts from each rod; run the carriage back, block it, and remove the inner nuts from the rods; unscrew the

stuffing box and remove it, and take out the old leather. The new leather must be thoroughly greased and carefully placed upon the rod, so as not to damage the edges, and well pressed home by the metal stuffing box before inserting the cotton packing.

In reconnecting the piston rods with the slide, care must be taken to replace the parts so that the adjusting gear for the buffer will be in working order.

To fill the buffers:—See that the carriage is hard against the front stops, and that the run-off plugs are screwed tight home; remove the filling plugs, insert the gallon measure in one of the filling holes, run in sufficient fluid to fill the cylinders (about 12½ gallons for each buffer). To draw off a small quantity of the fluid, the draw off plugs should not be unscrewed more than a quarter of an inch, as the fluid will flow through small holes drilled in the plugs for that purpose. To empty the buffers these plugs must be unscrewed entirely. The buffers may also be filled by using the running back pump for this purpose. If this method be preferred, connect the delivery pipe of the pump to the filling hole of the right cylinder, see that the release valve is closed, remove the filling plugs from the pump cistern, and pour in the fluid; work the pump till the fluid overflows at the filling hole of the left cylinder, replace the plug in this hole, and work the pump till the carriage begins to move, replace the plugs in the pump cistern. The working contents of this pump is six gallons.

To alter the size of the piston openings, slacken back the nut in front of the hand lever, and move the lever until the required amount of adjustment is indicated on the scale. The pumping nut must then be tightened up.

The elevating and traversing gears should be examined at least once a month, the teeth of the wheels should be greased, and the trunnion bearings lubricated with oil. The gun should be elevated and depressed, and the mounting traversed right and left to see that all the gear is in good order and working smoothly.

If the sprocket chain of the elevating gear should become too slack through wear, causing excessive back lash in the elevating hand wheels, the chain can be set up and the back lash reduced in the following manner: Place a spanner on the square of the guide roller gudgeon outside the left girder of the slide, slack back the nut securing the gudgeon, turn the square in the necessary direction, and tighten up the nut. Care must be taken that the chain is not made too tight. The back lash and the friction should be both at a minimum.

The truck axles should be occasionally removed and cleaned from clotted grease and dirt. For this purpose the ends of the slide must be slightly raised so as to take the weight off the trucks; in the case of the rear trucks this can be done by means of the hydraulic pivot. For the front trucks a jack must be used. The axles must be well oiled before being replaced.

The mountings must be lifted on the hydraulic pivot from time to time. Care must be taken that the oil in the pivot, tank, and connections is clean and free from grit. The pump valves and seatings must be examined occasionally and cleaned; this can be done by removing the screw plugs over the valves. The leather packings in the plungers and stuffing boxes, and the washers under the plugs and in the unions must be renewed when found necessary. Should the amount of vertical lift in the pivot be insufficient, it can be increased by adjusting the length of the outer link connecting the pivot band with the pump; the exact amount of lift can be seen on the index provided for the

purpose. If the mounting should at any time be removed from the pivot, the greatest care must be taken to protect the pivot, ram, and cylinder from abrasion.

The band round the pivot block must be periodically lubricated. This band must on no account be disconnected, or the joint pins withdrawn from the supporting frame, unless the carriage is dismounted and the slide properly blocked up, but this should only be necessary when the mounting is being removed.

To run the carriage back:—Hook the lifting derrick provided into the hole made in the top of the right hand side of the carriage, and hang the chain blocks on the end of the derrick; lift the pump into its place and clamp it down with the screws provided for that purpose. Connect the delivery branch of the pump with the filling hole of the right hand buffer by means of the connecting pipe provided.

To run back:—See that the release valve under the pump cistern is closed, and work the pump handles.

To run up:—Open the release valve.

As the running back gear is only provided for purposes of drill, it should be removed before commencing firing practice.

The running back pump must be examined occasionally to see that the valve seatings and other important parts are in good order; the valves can be got at by removing the plugs in the cistern and in the bodies of the pumps.

The leathers in the stuffing boxes, unions, and on the plugs must be renewed when necessary. The fluid used must be clean and free from grit.

To dismount the carriage:—Disconnect the buffer rods from the slide, and the front clips from the carriage, remove the rear buffer spindles from the slide; run the carriage back until it is in contact with the rear buffer stop brackets. The rear clips will then pass through openings in the upper flanges of the slide girder made specially to admit of the removal of the carriage.

Before firing care must be taken that all nuts and bolts are properly tightened up, that the piston rods are securely fixed to the slide, and that the fluid in the buffers is in accordance with the quantity specified on the inscription plate. The index to the buffer adjusting gear should also be examined to make sure that it indicates the correct amount of opening.

NOTE.—The register No. must be quoted in all correspondence relating to these mountings, to ensure identification.

MARK III MOUNTING.

All bright parts must be kept clean, slightly greased, and all working parts properly lubricated by means of the holes drilled for the purpose, and care must be taken to replace the covering screws after lubrication.

If the carriage rollers become clogged with clotted grease and dirt, they must be removed and cleaned. For this purpose the keeping plates must be removed, and the axles withdrawn, and the rollers rolled out.

If the buffer leaks at the gland, the gland must be screwed up, and if this will not stop the leak, the packing must be renewed.

To renew the packing:—Run the carriage back about 2 feet and block it in that position; empty the buffer by opening the discharge valve on the under side; unscrew the gland and slip it along the

piston rod to admit of the defective packing being extracted and replaced by the new packing, which must be well saturated with Russian tallow before being inserted.

If the leather packing requires renewal, it will be necessary to disconnect the piston rods from the slide before running back the carriage. To do this, take out the securing pins in the front nuts on the piston rods, and remove these nuts from each rod; run the carriage back, block it, and remove the inner nuts from the rods; unscrew the stuffing box and remove it, and take out the old leather. The new leather must be thoroughly greased and carefully placed on the rod so as not to damage the edges, and well pressed home by the stuffing box before inserting the cotton packing.

Reconnect the piston rods with the slide.

To fill the buffer:—See that the carriage is hard against the front stops, and that the discharge valve is shut; remove the filling plug, insert the gallon measure in the filling hole, and run in sufficient fluid to fill the cylinders (about $11\frac{3}{4}$ gallons for each buffer). To draw off a small quantity of fluid or to empty the buffers, open the discharge valve.

The buffers may also be filled by using the running back pump for this purpose. If this method be preferred, connect the delivery pipe of the pump to the filling hole of the right cylinder; see that the release valve is closed; remove the filling plugs from the pump cistern, and pour in the fluid; work the pump till the fluid overflows at the filling hole of the left cylinder; replace the plug in this hole and work the pump till the carriage begins to move. Replace the plugs in the pump cistern. The working contents of this pump cistern is 6 gallons.

The rear truck axles should be occasionally removed and cleaned from clotted grease and dirt. For this purpose the rear end of the slide must be raised so as to take the weight off the trucks. This may be done by using the hydraulic pivot, or by means of a hydraulic jack. As the front trucks are secured to the third motion shafts, the set screws in the trucks and the keys in the bevel wheels must be removed, and the front of the slide jacked up before drawing the shafts on end. The axles and shafts must be well oiled before being replaced.

The elevating and traversing gear should be examined at least once a month; the teeth of the wheels should be greased, and trunnion bearings lubricated with oil. The gun should be elevated and depressed, and the mounting traversed right and left to ensure that all the gear is in good order and working smoothly.

The mounting must be lifted on the hydraulic pivot from time to time. Care must be taken that the oil in the pivot, tank, and connections is clean and free from grit. The pump valves and seatings must be examined occasionally and cleaned. This can be done by removing the screw plugs over the valves. The leather packings on the plungers and stuffing boxes, and the washers under the plugs and in the unions, must be renewed when found necessary. Should the amount of vertical lift in the pivot be insufficient, it can be increased by adjusting the length of the outer link connecting the pivot band with the pump. The exact amount of lift can be seen on the index provided for the purpose. If the mounting should at any time be removed from the pivot, the greatest care must be taken to protect the pivot ram and cylinder from abrasion.

The band round the pivot block must be periodically lubricated; it must on no account be disconnected, nor the joint pins withdrawn from the block supporting the rear end of slide, unless the carriage is

dismounted and the slide properly blocked up, and this should only be necessary when the mounting is being removed.

To run the carriage back:—Place the lifting derrick provided into the hole made in the top of the right hand side of the carriage, and hang the chain blocks on the end of the derrick. Lift the pump into its place, and secure it with the keys provided for that purpose. Connect the delivery branch of the pump with the filling hole of the right hand buffer by means of the connecting pipe.

To run back:—See that the release valve under the pump cistern is closed, and work the pump handles.

To run up:—Open the release valve.

As the running back gear is only provided for purposes of drill, it should be removed before commencing firing practice.

The running back gear should be examined occasionally, to see that the valve, seatings, and other important parts are in good order. The valves can be got at by removing the plugs in the cistern and in the bodies of the pumps. The leathers in the stuffing boxes, unions, and other plugs must be renewed when necessary, and the fluid used must be clean and free from grit.

To dismount the carriage:—Remove the covers of the elevating worm wheel and sliding bracket, and take out the worm shaft. Remove the front and rear clips from the carriage; disconnect the buffer rods from the slide; and run the carriage back till the ends of the rods are clear of the front transom of the slide. The carriage can then be lifted out.

Before fixing, care must be taken that all nuts and bolts are properly tightened up, that the piston rods are securely fixed to the slides, and that the fluid in the buffer is in accordance with the quantity specified on the inscription plate.

NOTE.—The registered number must be quoted in all correspondence relating to these mountings, to insure identification.

CARRIAGE, GARRISON, DISAPPEARING, B.L. 10-INCH, MARK I.

(Plates XI, XII, and XIII.)

The principal parts of the carriage are:—

1. The circular platform or turntable, which is placed in the second pit, with its top surface level with the floor of the gun pit. (B, Plates XI and XII.) For facility of transportation this piece divides into four pieces, namely: the front piece, which weighs about 5 tons; the rear piece, which weighs about $2\frac{1}{4}$ tons; the two side pieces weigh each about $1\frac{1}{4}$ tons.
2. The main girders, which span from side to side of the circular platform, carrying the recoil cylinder between them. (B', Plate XI.) These weigh each about $1\frac{1}{2}$ tons.
3. The rocking carriage or elevator, with the crosshead, which is made up into one piece, weighing about $4\frac{1}{4}$ tons. (A, Plate XI, and K, Plate XIII.)
4. The recoil cylinder and ram together make the heaviest piece, and weigh $6\frac{1}{2}$ tons. (H and J, Plate XIII.)
5. The live rollers, which are held in place by the live roller ring, and run between the upper and lower roller paths. (W, Plate XI.)

6. The rack fixed to the lower roller path, with the traversing gear working into it, and carried on the circular platform.
7. The elevating gear. (Fig. 2, Plate XIII.)
8. The carriage is also provided with a large overhead shield, somewhat less in diameter than the mouth of the gun pit, and of a thickness of one inch. (C, Plates XI and XII.)
This shield is stiffened on the under side by plate and angle beams, and is supported from the circular platform by eight pillars, constructed of angle bars. (C', Plate XI.)
For facility of transport and erection, the shield is made up into four pieces, each weighing about $5\frac{1}{2}$ tons.
Besides the above there are many minor fittings, such as:—
 - (a.) Mirrors for laying the gun from under cover. (F, Plates XI and XII.)
 - (b.) Rough sights on the shield for approximately laying the gun before it is raised above ground. (F', Plate XI.)
 - (c.) A pump on the recoil cylinder, for getting the gun down without firing it. (S, Plate XIII.)
 - (d.) A set of hand rails, under the shield, around the chase of the gun, to prevent a man from standing where the gun might strike him, if fired. (C', Plate XI.)
 - (e.) A set of cut-off gear, acting upon the lever which controls the motion of the gun raising valve, to bring the gun gently to a stop at the firing position. (T', Plate XIII.)
 - (f.) Securing gear, to lock the gun down. (XX, Plate XIII.)
 - (g.) Ladders, to reach the top of the shield.
 - (h.) Hinged platforms, for obtaining a standing position behind the gun sights; these being made to spring clear of the gun after use.
 - (i.) Indicator, and direction plates, as guides in working the carriage.

DESCRIPTION OF PLATFORM.

(Plates XI and XII.)

The circular platform, with its main girders, is constructed of mild steel plates and angles. It has no actual centre pivot, but is held in place, so as to revolve about its centre, by double flanged live rollers, which take on the upper and lower roller paths (Y); and by the front and rear clips, which prevent more than a trifling lift from taking place when the gun is fired. The front clips (E) are 5 and rear clips 3 in number, made of cast steel, of a form to hook under a rim formed for the purpose on the lower roller path; they are each secured to the circular platform by 13 large bolts. The platform is fitted with sockets and footsteps for the shield pillars, and at its front end with the brackets for the pivot of the rocking carriage.

Between the circular girder at each side and the main girders there is room for the numbers employed in traversing and elevating the gun, and a chequered foot plate is provided for them to stand on, about $2\frac{1}{2}$ feet below the level of the floor of the gun pit.

CARRIAGE OR ELEVATOR.

(Plate XIII.)

The rocking carriage consists of two cast steel beams of curved form, united together, wherever there is space clear of the gun, by cross transoms. At the top they are formed into bearings for the

gun-trunnions, and are fitted with capsquares. These capsquares slide into place from the outside, and are secured there by dog tailed pins, made with a spring and key to prevent them from being shaken out. The arms of the recoil ram crosshead pass through bushed holes near the centre of the rocking carriage. This crosshead therefore cannot be taken out when the beams and cross transoms of the rocking carriage are once rivetted up. At the bottom the beams of the rocking carriage have bushed holes for the pins on which it pivots when the gun goes up or down.

RECOIL CYLINDER.

(Plates XIII to XIII^D.)

The recoil cylinder is bored out from a solid ingot of mild forged steel. This method of construction is adopted to get rid of the uncertainty attendant upon the manufacture and employment of a casting, but it has also the great advantage that the compressed air used for counterbalancing the weight of the gun is contained in about a dozen chambers in place of one, so that if the cylinder were torn open by being struck in action, the compressed air would escape only slowly and without explosive effect. The cylinder is screwed into a cast steel trunnion ring, the trunnions of which are supported in brackets fixed to the main girders of the platform. The centre of the cylinder is bored out for taking the recoil ram, and is fitted at the top with a packing gland. (R, Fig. 1, Plate XIII.) To prevent the ram from coming out of the cylinder at the end of its stroke, it is provided with a divided piston, and there is also a divided internal collar at the top end of the cylinder. The lands and grooves thus formed allow the ram to pass in or out, but when partially turned round the ram is locked, and prevented from coming out again. From the inner cylinder to the air chambers passages are cut, and these are fitted with six recoil valves, which permit liquid to pass from the inner cylinder to the air chambers, but not to pass back again. These recoil valves can be reached by removing the end plugs. (M, Plate XIII.)

For the liquid to pass back again when the gun has to be raised, a rising valve is provided at L, and this is opened by a rack and pinion moved by the rod T and hand lever D. It is shut automatically as the gun rises by a chain attached to the cross-head and rocking carriage, which also acts upon the rack and pinion through the rod T. Near the middle of the cylinder, on the top side, is a filling cock (N) and a liquid level cock (P). An air cock, giving a vent to the inner cylinder, is fitted at the top of the cylinder at Q.

The recoil ram is made of manganese bronze. It is fitted at the top with a spring draw buffer. (See Fig. 1, Plate XIII.) This is made up of 15 dished spring washers (KK), and the draw bolt (JJ) which connects the crosshead to the ram. This arrangement allows the crosshead to be drawn off the ram about $2\frac{1}{2}$ inches, against the action of the spring, if it should happen that the gun rises too violently into the firing position.

ROLLERS.

The live rollers are carefully coned to suit the circle round which they travel, and being all of the same size, they have therefore no tendency to get out of place; nevertheless, it is considered safer to

hold them in place by a live roller ring, with an axle pin through each roller. The only weight which comes on the axle pins is that of the live roller ring, but the rollers are bushed with gun metal to prevent them from rusting fast to their axles. The advantages of mounting the carriage on live rollers in place of an actual pivot are, first, that the shifting of the gun from one position to the other does not alter the amount of work to be done in traversing the gun; and, second, that with properly made roller paths and rollers the work of traversing is extremely small, a force of only about 8 or 10 pounds being required for each ton of weight moved. Thus, in the present case, the revolving weight of gun carriage and shield is, say, 82 tons, so that the application of a horizontal force of, say, 800 pounds at the radius of the roller path will produce motion.

RACK.

The rack fixed to the lower path is made in steel, in short lengths. The teeth are placed vertically, so as not to get choked with dirt. There are 270 teeth in the complete circle, that is, each tooth is a degree and one-third.

The rest of the gear used for traversing the gun is carried on, and therefore revolves with, the platform. On each side is a pinion with twelve teeth gearing into the traversing rack, and driven through the third motion shaft by a spur wheel which has 54 teeth. Into this spur wheel a pinion of 12 teeth on the second motion shaft is geared. The second motion shaft is driven from a bevel wheel and bevel pinion, of 40 and 14 teeth respectively, contained in the box guard, on the top of the circular platform. The first motion shaft, on which the last pinion is fixed, has a 3-foot hand wheel (WW, Plate XI), with a crank handle keyed to it. For traversing a short distance it will be found most convenient to haul on the top of the rim of the hand wheel, but for a long distance the crank handle is more easily worked. The speed of travel of the rim of the hand wheel is 69 times that of the platform at the radius of the roller path, so that the power to be applied at the rim of the hand wheel is $\frac{1}{69}$ th of the 800 referred to above, that is to say, about twelve pounds. There is an indicator plate marked "right" and "left," meaning "trail" to the right or left.

ELEVATING GEAR.

The elevating gear gives elevation or depression to the gun by means of two long rods (AA, see Plates XI, XII, XIII), which are pivoted at their upper ends to an elevating band tightened on the breech end of the gun, and are hinged at their lower ends to the toothed elevating arcs (BB, Fig. 2, Plate XIII), actuated by a train of toothed gear and hand wheels fitted to the carriage. This gear has an elevating shaft (YY), provided with an automatic regulating brake, (EE) for the following reasons:—

When the gun is in the firing position, and it is necessary for the purpose of laying on an object to depress it, the elevating rods (weighing about 660 lbs.) have to be lifted by the elevating gear; but if the gun has to be elevated the weight of these arms is sufficient to make the gear run away when once put into motion. This is compensated for by the brake, which is made with a friction pawl

which grips the drum (NN) when the gear revolves in the direction required for elevating the gun, so as to turn the drum on its cone, and set up enough friction to more than counteract the weight of the arms (AA). When, however, the gear is turned in the opposite direction, the pawl slides freely over the drum so as to avoid turning the brake. The springs (JJ) should be adjusted to hold the drum and cone together till the friction produced is the right amount. This may be very fairly judged by making the power required on the hand wheel for elevating the gun the same as that for depressing it.

The main elevating shaft (CC) is not rigidly keyed to the cog wheel (LL), but is driven by friction plates of alternate steel and bronze (MM). These plates should be tightened into the wheel by the spring (GG) and the nut (HH) sufficiently to insure that the cog wheel will not slip round without moving the shaft (CC) under ordinary circumstances, but that it shall so slip whenever the shaft is jerked violently round when the gun is fired. This frictional driving apparatus is introduced to prevent the teeth of the wheels from being overstrained. It is of importance that the spring (GG) should be properly tightened. This can be tested by fixing the shafting (CC) so that it cannot revolve, and by then hanging a weight of about 95 lbs. on each hand wheel at a radius of about $12\frac{1}{2}$ inches from the centre. This weight should just cause the gear to slip.

The range of elevation and depression at which the gun can be fired is from 15° elevation to 5° depression, and the elevating arc guide on one side of the carriage is graduated to this extent in degree markings, and is inscribed "not to be fired beyond this mark" at each end. The elevating arcs have a long range of travel, because when the gun is fired it is necessary to let them follow the movement of the gun. The arc guides are fitted with spring buffers to check the movement of the arcs if they run up too violently.

SHIELD.

The overhead shield is intended to keep out fragments of shell bursting overhead. It also makes a very good roof. In hot climates the shield may be covered with a non-conductive material to keep the gun pit cool. It may be used for a look out platform when the enemy are at a long range, and if Scott's sights are fitted to the trunnion of the gun, they can be conveniently manipulated from here. There are two ports or man holes through the shield, each provided with a ladder from below. The forward port has in front of it a pillar, which serves both as a help in getting up and as a socket for a rough back sight, by which, with the aid of a similar fore sight, the gun may be brought approximately into correct line before being put into view. The rearward port is near the hinged platforms, from which the gun can be sighted by the service sights on the gun. These ports are also fitted with cover plates, which are put in place from below, and are fastened on the under side.

Of the minor fittings of the carriage the following is a description:—

LAYING MIRRORS.

(a.) The mirrors (F, Plates XI and XII) for laying the gun from under cover are made to slide out of their outer frames so as to be

dismountable when not in use. They are silvered by a special process, which insures the silver remaining on the glass, and the silvered plate is hermetically sealed into the inner frame, to prevent moisture from getting to the silvering. Small plates and set screws are fitted to the mirror frames, for the purpose of stretching a fine line vertically across the face of the glass, as close to the glass as possible. It may however be found that the view of the target is somewhat marred by the two lines and their reflections, and that a better aim can be taken if two lines wide enough apart to allow a view of the target between them, are stretched over the top mirror, and if the line on the bottom mirror is dispensed with. If the atmosphere is damp, a little pure glycerine may be rubbed over the faces of the mirrors to prevent them from getting clouded by the moisture.

PUMP.

(c.) The gun metal pump (S, Plate XIII) on the back of the recoil cylinder is a double acting force pump, that is to say, it makes a suction and delivery with both the up and down stroke. It has two suction and two delivery valves fitted with small phosphor bronze springs to help them to shut, and is worked by a lever (SS, Plate XIII) with a cross handle. The pump is fixed to the recoil cylinder because the cylinder oscillates on its trunnions when the gun rises and falls; otherwise it would be necessary to connect the pump to the recoil cylinder by flexible suction and delivery pipes. The pump has a constant stroke of 4 inches, but to obtain this, under the varying positions it is thrown into by the oscillations of the cylinder, it is necessary to make the pump longer by 2 inches, or the amount of the oscillation. The pump transfers the liquid from the inner cylinder to the air chamber of the recoil press. The weight of the gun assists this action, so that the work of the pump is only to reduce the pressure under the recoil ram till the gun can descend by its own weight.

CUT-OFF GEAR.

(e.) The cut-off gear (T¹ and T, Plate XIII) is provided in order to make sure that the raising valve gets moved towards the closed position as the gun nears the firing position, so that the gun's speed may be gradually checked. The cut-off is not intended to entirely close the valve, although the chain may be screwed up short enough to make it do so, but this is not recommended, as it involves loss of time, the speed being so extremely slow towards the last. The valve is intended to be finally closed by hand, and may with care be entirely so worked if the cut-off gear happens to be damaged or out of order. The chain of the cut-off gear is attached to the crosshead and to the rocking carriage; these points are so chosen, that if the buffer in the cross head comes into action, the cut-off chain is not drawn tighter by the extra forward movement of the gun, because the part attached to the crosshead slackens as much as the part attached to the carriage is overdrawn. There is a right and left hand coupling to the cut-off chain for the adjustment of the length, and check nuts to fix it when adjusted.

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SECURING GEAR.

(f.) The securing gear (XX, Plate XIII) is fitted for holding the gun down, so that the carriage may be left without fear of the gun rising, which might happen either from the valve being left partially open, or from interference with the hand lever by unauthorised persons. It consists of a pair of hooks which are hinged to the main girders of the circular platform, and can be hooked over the flanges of the beams of the rocking carriage. These hooks are made with a set screw at the top, the point of which can be screwed into a shallow hole in the flange of the beam of the rocking carriage, so that when put in place they cannot well be undone without a spanner of the right size. When in use both hooks are intended to be used at the same time.

The weights of the carriage are:—

	Tons.	cwts.	qrs.	lbs.
Upper carriage with crosshead	4	6	2	0
Lower carriage with elevating and training gear ..	15	18	2	15
Cylinder, ram, and lowering pump	5	15	2	9
Roller path, clip ring, and rack, &c.	3	19	3	14
Live roller ring with rollers and pins	2	10	2	20
Holding down bolts and anchor plates	5	18	0	2
Shield and attachments	22	9	1	22
Sighting and look out ladders	0	4	3	25
Total	61	3	2	23
Air pump	0	8	2	26

CARRIAGE, GARRISON, DISAPPEARING, B.L., 10-INCH,
MARK II.*

(Plates XIV and XV.)

The body of the carriage consists of a pair of steel beams connected together so as to form a solid frame (A). Towards the middle of the lower side of the frame is a pivot plate fitted on to a pivot piece (B), securely bedded in the masonry or concrete of the emplacement.

The outer ends of the frame are carried on two pairs of cast iron wheels or rollers (C), travelling on a roller path embedded in the floor of the emplacement.

On the upper side of the frame towards the middle are secured a pair of cast steel pedestals (D), which carry a steel rocking shaft (E), on to which are keyed by cap squares a pair of bent wrought iron elevators (F), the upper ends of which are formed into bearings for the trunnions of the gun, and fitted with cap squares.

The lower ends of the elevators are connected by a wrought iron shaft (G), round the middle of which is clasped the outer end of a connecting rod (H), the opposite end of which abuts into a recess in the bottom of a hollow trunk or plunger (I), which works into the horizontal recoil cylinder (J), through a gland packed either with leather or hemp packing.

* Originally called Easton and Anderson (E and A) Mounting.

The plunger is a little smaller in diameter than the cylinder, but terminates in an enlargement or piston which fits the bore, and serves at once as a guide, an automatic throttle valve, and a stop to prevent the ram being forced out too far.

The cylinder is of cast steel, and is secured to the side girders of the main frame.

Planted on the rear end and top of the cylinder (J) are two automatic recoil valves, which communicate by means of the pipes (L) with two steel plate air vessels (K),* placed horizontally one on each side of and over the cylinder.

When the gun recoils the connecting rod (H) and the plunger (I) are forced into the cylinder; and the liquid with which the cylinder is filled is driven through the recoil valves into the air vessels, compressing the air contained in the latter. The valves being "non-return," the liquid cannot return through them to the cylinder.

NOTE.—The letters F², G², H², I², and M², represent the parts designated by F, G, H, I, and M, when the gun has recoiled into the loading position.

Leading from the lower sides of the air vessels to the recoil cylinder is a pipe controlled by a screw stop valve, and on opening this valve (the gun having recoiled and the air in the vessels being compressed) the liquid in the air vessels is forced back by the compressed air into the cylinder, driving out the plunger and connecting rod before it, and thus by means of the elevators elevating the gun into the firing position. As the gun nears the firing position, a port which controls the passage of the liquid into the cylinder, slowly closes, and the gun is brought gently to rest.

Buffers are provided to check the gun both in its downward and upward movements.

The elevating arrangement consists of an elevating band secured to the breech end of the gun, to which are attached a pair of elevating rods (M), the lower ends of which are attached by elastic connections to a shaft which crosses from side to side of the frame, the ends of which are fitted into racks (N), working into guides secured to the inner faces of the girders forming the frames. The racks are elevated by gearing, and the two racks are worked simultaneously by spur wheels actuated by hand wheels (O) on either side of the carriage. A graduated scale (S) indicates the degree of elevation of the gun. A friction clutch is introduced so as to avoid sudden shocks to the gear.

The traversing of the carriage is effected by handles (P) on each side of the frame, which actuate the front wheels or rollers by means of suitable gearing.

Two pairs of pumps, one for water and one for air, are placed in the front transom, and are actuated by a cross shaft and hand wheels (Q) on each side. These pumps are intended for forcing air or water into the air vessels, or for lowering the gun from the firing into the loading position; this is effected by pumping the water from the cylinder into the air vessels.

The pumps are thrown in and out of gear with the cross shaft by means of forked clutches (S) acting on the wheels, and a slow and quick gear is provided for each pump.

* These vessels are not shown in Plate XV, in order that the cylinder (J) may not be hidden. The two holes (L and I) in Plate XV represent the pipes leading to the air vessels cut across.

The water pump is provided with two suction, which can be opened or closed by means of stop valves. When facing to the rear the valve on the right opens communication between the pump and the recoil cylinder, and is used when pumping down the gun into the loading position; that on the left opens to a flexible hose, which is used to draw from a bucket when more water is required in the cylinder.

On the front end of the right air vessel is fixed a pressure indicator and also a dead weight gauge.

On the front of the left air vessel is a glass water gauge. When the gun is down, the water should stand at a line marked on the glass. These gauges are covered by sliding lids; as a rule they should be kept shut off from the air vessels.

The men attending to the traversing, elevating, and pumping are protected by the parapet from the enemy's fire. The shell is brought up on a barrow, which is run over a tray carried on the end of a curved rack (T); the rack being run up through suitable gearing by means of the handles (R), raises the shell to the level of the gun, and it is then pushed home by means of an ordinary rammer. The following are the principal dimensions:—

Diameter of gun pit at top	34·0 feet
" " bottom	40·0 "
Depth to upper surface of racer	13·0 inches
Fall of gun vertically	9·0 feet
Length of trunnion path	14·3 inches
Diameter of recoil cylinder.. ..	32
Stroke " "	3 feet 11 $\frac{3}{8}$ inches
Air pressure—gun up	238 lb. per sq. inch
" " down	407 "
Water level distance below top of base of gauge glass	48 inches

CARRIAGE, GARRISON, DISAPPEARING, B.L., 10-INCH.
MARK III.

(Plate XVI.)

This carriage is designed to be placed in a pit, into which the gun disappears for loading; all the operations necessary to the working of the gun can be effected while the gun is under cover. The gun rises and falls through a vertical height of 9 feet.

The mounting consists of two cast steel elevators, a ring girder, with trucks and traversing gear, two main cross girders, with transom and stays, which support the elevator bearings; a system of bars and links which guide the motion of the gun during recoil; two hydraulic buffers, one of which absorbs a certain amount of the energy of recoil, and admits of an axial movement of the gun, while the other absorbs the remainder of the energy and brings the gun to rest, storing up, in the air chamber attached to it, a sufficient amount of power to return the gun to the firing position when required. The mounting

is also provided with a cradle (*l*) in which the gun is secured by its trunnions, and a slide (*n*) on which it makes its axial recoil, and to which the elevating gear is attached.

The mounting is fitted with a platform (*A*), from which the gun is loaded; this platform is supported by the cross girders, and by 4 columns on the ring girder, a derrick, on which is a sighting platform, a shot hoist for lifting the ammunition, a hydraulic pivot to facilitate traversing, and a differential pump for supplying liquid and air under pressure to the buffers and air vessel, and for pumping the gun down.

The racers (*B*) consist of two concentric rings of steel rail of heavy section, with the top surface turned to the required cone. They are fixed down to the pivot block with steel screws and clip plates.

The traversing rack (*C*) is of cast iron in 12 arcs. It is secured to the pivot block by steel screws.

The ring girder (*D*) is of box section, built up of steel plate and angle, and fitted with wrought iron flanged bearings for the trucks. These bearings are made eccentric to allow of adjustment. Removable cover plates are fitted to allow of the trucks being placed in position and withdrawn.

The trucks are of forged steel, running in pairs on the concentric racers, and so arranged as to meet the strains to the best advantage, viz., four pairs in the rear, three in the front, and two on either side.

The cross girders (*E*) are of steel plate, rivetted to cast iron frames. They fit inside, and bear on the top of the ring girder, to which they are secured by steel angle pieces. They are connected at the centre by a box transom (*a*) of steel plate and angle, and stayed in position by plate and angle stays running out to the ring girder.

The centre transom (*a*) carries the weight of the whole of the moving parts of the mounting when the trucks are relieved by the action of the hydraulic pivot.

The platform (*A*) is of steel plate covered with chequered boards, and supported by columns and cross girders of steel plate and angles. A manhole with ladders and hand post is provided to give access to the lower part of the mounting.

The hydro-pneumatic buffer is of telescopic construction, consisting of a cylinder (*b*) in which works an inner ram (*c*) and outer ram (*d*). The total stroke is about 10 feet.

The rams are of steel, with phosphor bronze rings at their lower ends, which fit inside the outer ram (*d*) and cylinder (*b*) respectively, but for the greater part of their length they have clearance, and holes are drilled to allow the liquid from the space around them to escape into the centre.

The inner ram (*c*) at its upper end fits into a forged steel cross-head which carries the slide, and is connected with the axial recoil buffer by a steel pipe (*e*) with swivel unions. When the gun is down, this ram rests on the end of a steel plug at the bottom of the cylinder. This plug acts as a dead stop to relieve the link work from strain.

The outer ram (*d*) at its upper end fits into a forged steel cross-head (*f*) provided with glands to make a joint round the inner ram (*c*), and with trunnions for the bars and links by which it is connected with the system of linkwork which guides it in its correct path of motion. As the gun completes its recoil, this ram forms a gradual stop by passing over the plug before referred to, which, being tapered, gradually closes the opening and increases the resistance.

The hydraulic buffer cylinder is screwed into a steel casting, into which the air vessel is also screwed. This casting is provided with

trunnions (*g*), on which it oscillates in cast steel bearings fitted into the cross girders and secured by steel bolts.

The air vessel (*h*) is of forged steel, cylindrical in form. It is fixed parallel to the hydraulic buffer, to which it is attached by a forged steel band (*i*).

A floating drum or piston is placed within the air vessel to prevent the mixture of the air with the liquid, and the consequent disadvantage of air entering the buffer. During recoil the air vessel is in communication with the hydraulic buffer by six adjustable valves, which regulate the length of the recoil, and a release valve to allow the return of the gun to the firing position. The recoil valves are arranged in a circle with the release valve in the centre.

The lift of the recoil valves is regulated by stops screwed down behind them, and actuated simultaneously by pinions on their ends engaging with an annular wheel, rotated by a screw, so that the lift may be varied with certainty from zero to 0.6". An indicator dial is provided to read to thousandths of an inch by means of a vernier. The release valve is lifted and controlled by a forged steel lever and screw and a hand wheel (*k*) of gunmetal. It is intended to be gradually closed by the operator as the gun approaches the firing position, in order to prevent the shock of a sudden stoppage.

The top carriage or cradle (*l*) is of cast steel, with a manganese bronze band (*m*) passing over the gun. It is formed so that the gun rests on the bottom, and is prevented from turning by trunnion bearings. The gun is secured in position by capsquares and by the manganese bronze band (*m*), tightened by a cotter over the breech. This carriage is provided with a lug projecting from the under side, to which the piston rod of the axial recoil buffer is secured.

The slide (*n*) consists of two steel forgings, connected by the crosshead and by the axial recoil buffer, which serves as a transom, and also carries the stud for the elevating gear. The crosshead works in phosphor bronze flanged bearings. The slide (*n*) is provided with guides and with front buffer stops for the top carriage.

The axial recoil buffer cylinder and piston rod are of forged steel. The buffer is secured between the sides of the slide (*n*) by steel screws, and the front end of the rod is attached to the lug on the top carriage by a nut.

The gun in making its axial recoil forces the liquid out of this small buffer, through the steel pipes (*e*) and the top crosshead into the main buffer, from which it is returned by the increasing pressure in the latter as the gun comes down. The gun is thus forced back into the firing position on the slide during the recoil.

The main links or elevators (*o*) are of steel plate and angle, connected by transoms. They are carried by a cross bolt (*p*) of forged steel, in bearings in the cross girders at the lower ends, and at the top are provided with bearings for the top cross head. They also have rivetted to them wrought iron flanged bearings, for the shaft carrying the bars by which they are connected to the outer ram (*d*).

The remaining links and bars are steel forgings, those connecting the main links with the crosshead of the outer ram (*d*) being given lateral stiffness by having a length of T section steel rivetted on.

The system of link work consists of two parallelograms, one within the other, and each having the main links and the line of bearings in the cross girders as two of its sides. The inner parallelogram forms the guide for the outer ram (*d*), while the gun affords a point of support for the elevating gear, so that the gun at whatever elevation it is fired remains parallel to that elevation.

during recoil. The outer bars (*g*) also form guides for the hydraulic buffer by means of a sliding band provided with trunnions working in bearings in the links.

The elevating gear is arranged to give 15° elevation and 7° depression. It is constructed of two parallel forged steel screws (*r*), rotated in phosphor bronze nuts by bevel and spur gearing driven from a cross shaft running in bearings in the links, and provided with a hand wheel (*s*) at each end. The nuts are carried in forged steel sleeves (*t*) attached to a forged steel balance lever, jointed at the centre, and arranged to permit slight movement in all directions to prevent cross strains.

A hydraulic pivot (*u*) is provided to relieve the trucks of all or the greater part of the weight of the gun and mounting while traversing, in order to reduce the load on the winch handles. It consists of a cylinder and ram fixed at the centre of the pivot block. The ram bears upward against a heavy steel plate at the bottom of the box transom (*a*) in the centre of the carriage. Liquid is forced into the cylinder through the ram by a pump attached to one of the cross shafts. This pump has two rams, worked from a continuation of one of the traversing-gear shafts by a crank and an eccentric respectively; these are so arranged that their relative position can be adjusted to give a differential action to the rams. By means of a clutch and lever, one plunger can be disconnected from the traversing gear and worked direct by a winch handle. The direct gear is used for lifting the carriage before commencing to traverse. During traversing the clutch is in action, and the pump then sustains the weight and supplies the loss by leakage. A lever is provided which, being held down by the pivot as the carriage rises, indicates the height of lift by means of a pointer, and, when the required height is reached, raises the suction valve from its seat, and so throws the pump out of action. A release valve is also provided, worked by a hand wheel near the traversing gear, to lower the carriage on to the trucks before firing.

The pivot ram is not provided with any leather or other packing. Any liquid that leaks past the ram is caught in a tray in communication with a tank that supplies the pump.

Traversing is effected by two independent trains of bevel and spur gear, terminating with pinions engaging the traversing rack. These trains are actuated by winch handles, provided as follows: 2 to accommodate 12 men on the loading platform, and 2 to accommodate 4 men on the stages beneath. These handles can all be worked simultaneously. When the hydraulic pivot is in action the 4 men beneath the platform can traverse the mounting; the winch handles above the platform would then be removed. With the full complement of 16 men traversing can be effected independently of the hydraulic pivot. Stages are attached to the ring girder for the men below the platform, in order that they may not have to shift their footing while working.

The loading gear consists of a built up steel derrick (*v*) pivotted in the platform, and in a bracket on the ring girder to the rear of the gun. It is provided with a hand rope to pull it into any required position.

The lifting rope is attached to a shackle at the head of the derrick, from which it passes through a single sheave block (*w*), and back over a fixed sheave, then down through the post of the derrick, and, by guide pulleys, to a winding drum attached to the ring girder, and worked by a winch handle. This drum is provided with a ratchet and pawls, to stop it at any point on the handle being

released, and is arranged to lower the projectile with a brake held on by a weight, and taken off by a lever placed in a convenient position on the platform.

At the top of the derrick is fixed the sighting platform (x), provided with a hand post and hand rails, and reached by a permanently fixed ladder (y).

The charging pump provided is portable, and is designed to deal with either liquid or air up to the highest pressure required. It consists of two spherical chambers and two double ended plungers, which reciprocate between them, and which can be adjusted so as to work together, or to nearly neutralise each other, giving either a large delivery or a high pressure, as may be required.

The plungers are actuated by connecting rods and levers from a double crank shaft driven by hand wheels, and the adjustment of their relative position is provided for by a clutch coupling between the cranks.

The crank shaft bearings are carried by cast iron standards bolted to a cast iron base, which forms a tank for containing a supply of liquid.

The suction pipe for liquid and the air inlet are fitted with strainers, and a three way cock is provided to admit either air or liquid as required. Flexible suction and delivery pipes are provided to connect the buffer with this pump when it is used for pumping the gun down.

Holding down brackets are secured to the cross girders on either side with shackles, which fit over brackets on the main links to prevent the gun rising into the firing position should there be any leakage through the recoil or release valves.

The pivot block is of cast iron, in six segments, firmly bolted together, and united at the top by a cap which forms the cylinder for the hydraulic pivot ram. This cap is also arranged to pass through a hole in the central transom, thus forming a pivot pin which guides the mounting round on its racer. The pivot block is intended to be bedded in concrete.

Height of trunnion above racer	..	..	21' 4.25"
" pivot block	..	..	5 9
Diameter of racers	..	{ inner	9 9.25
	..	{ outer	10 2.75
Weight of mounting (estimated)	..		53 tons 12 cwt.

INSTRUCTIONS FOR ERECTION AND WORKING

10-INCH H.P., MARK I.

Before the erection of the mounting is commenced, the following points must be attended to:—

- I. The racer should be perfectly level.
- II. The roller paths (upper and lower), teeth of traversing rack, underside of clip ring and rollers should be quite clean and free from burrs.

- III. It should be seen that the roller ring has not been bent. The rollers and axles must be oiled, placed in the roller ring, and the ring given two or three revolutions on the roller path before putting on the mounting, to ascertain whether it runs truly, and that every roller bears continually. Two to four men should be able to move it freely.

The roller path on the underside of the mounting having been cleaned, oiled, and any burrs removed, the mounting should be lifted into position.

The traversing gear should next be attached, and one or two revolutions made to see that the mounting traverses freely. The truth of the racer may be tested here by a spirit level placed on any part of the mounting; as the mounting is revolved the bubble should remain stationary. The brackets for the pillars supporting the shield, and the front and rear holding down clips having been added, another revolution should be made, to ascertain that the clips do not bind on the clip ring. Two men should traverse with ease. The chequered foot plates should then be placed in position, and the lever handle of the raising valve keyed on its shaft. The cylinder is issued empty, and must be charged with liquid of the nature laid down in List of Changes, § 5346, which is:—

Methylated spirits	7 gallons
Distilled water	3½ "
Mineral oil	¼ gallon
Carbonate of soda	250 grains

and no other than the authorized liquid should be employed. About 70 gallons of the liquid will be required.

Before filling, attach the indicator connection to the filling cock on the cylinder, and fix the indicator in its place, taking care that it is cut off by screwing up the valve of the connection, as otherwise the indicator may be injured by pumping. It should stand within 15° of the vertical. Attach the copper pipe to the connection.

To fill the cylinder—(1) open the inlet at the connection, the raising valve (L, Plate XIII) and the plug at the top of cylinder (Q), close the water level cock (P, Plate XIII), and pump liquid till it flows out at the top plug. In pumping liquid with the "Pump, air, double," the pump cisterns must be kept full and the valve for liquid opened, the strokes must be *slow and steady*, otherwise air also may be drawn in. In pumping air, the liquid valve is closed, and the strokes should be quick and jerky. (2) Close the top plug and raising valve, and pump liquid till it blows out in a spray from the water level cock which should be opened every now and then to ascertain whether the liquid has risen sufficiently. (3) Change the pump to air, and pump air till the required pressure is shown on the indicator. The pumping should be stopped while the indicator is open to the pressure. The working pressure is 1,600 pounds per square inch gun down, and 800 pounds per square inch gun up.

For taking these pressures the elevator is "up" when it will rise no further with the raising valve open. Care should be taken not to allow the stops on the ram and cylinder (inside) to come into contact with force, or they may be burred, and the subsequent recoils and elevations affected. The raising valve should therefore be cut off gradually as the ram nears the end of its stroke; this is shown by the arrow heads on elevator and bracket.

In the "up" position two pencil marks should be made on the ram, one level with the top of the gland, and the other 46 inches from it.

The upper mark will show the "down" position, and should be used as the datum for measuring the recoils so long as the gland is undisturbed.

The elevator should not be let up with the full pressure behind it unless the gun is mounted, as it cannot be pumped down without straining the pump.

It is advisable to adjust the cut-off chain before mounting the gun, though it can be done at any time, and it is adjusted before issue. It should be sufficiently slack to allow the elevator to come fully "up," but without much jerk. The completing of the closing of the valve should be done by hand before pumping down or firing.

Pump down to the buffer stops, and secure the elevator by the holding down links before mounting the gun.

The gun may now be mounted, the elevating rods fixed in position, and the shield put on.

The shield segments have lifting loops placed at the centre of gravity; they are turned with the nut on top for housing. The overlapping flanges of these segments should be observed, as the segments must go on in a certain definite rotation.

Particular care must be taken that the elevating arcs and pinions are put together correctly, as otherwise damage will occur. The distance between the centre of the trunnion of the crosshead and the centre of the pin of the elevating arc must be the same on both sides. The correct position of the elevating arcs and pinions for gearing together is indicated by scribed lines on the elevating shaft pinions and arcs, and the two pinions are stamped "Right" and "Left" in addition; the lines on either side should coincide in one position.

The degrees marked on the arc guides for quadrant elevation are graduated so as to be correct for the "up" position, and should be checked at zero, and maximum elevation and depression with a long base clinometer on the quadrant plane of the gun. The graduations are only correct when the elevator is fully "up," and the gun should never be fired unless it is so. To ensure this, the cut-off chain should be sufficiently slack to allow a slight sound of contact between the stops in the cylinder to be audible to the No. at the raising lever.

The friction cone of the "equalizing" gear should be tightened just sufficiently to prevent the elevating arcs running down of themselves when the gun is up. This will be arrived at by trial. The cone or plates of the elevating gear should be tightened if there is much slip of the elevating arc on firing. A slip of 3 or 4 inches of the arc should be allowed. Where the arrangement consists of alternate plates, care must be taken in putting them together that steel does not come against steel, and that the faces of the plates are free from burrs, &c.

Before raising the gun, clear away any covering plates from the shield. For the first time the gun should be put up slowly and carefully, and the cut-off gear readjusted for length if necessary. *It is always necessary to make sure of the closing before firing, by pulling over the lever by hand when the gun is up.*

The liquid of the cylinder while in the air chambers becomes aerated to a certain extent, and when it passes into the inner cylinder the air is given off and collects at the top. This should be freed by loosening the plug Q (Plate XIII) on the top of cylinder every now

and then during the firing, otherwise the recoil may become excessive. The presence of too much air in the inner cylinder may be recognized by the ram "cushioning" at the end of its stroke instead of coming to a dead stand.

In using the lowering pump, the pump handle (S, S, Plate XIII) (which is suspended from the shield when out of use) is put into working position and pinned there. Six men are required to work this pump. Care should be taken to see that the gun commences to descend as soon as pumping begins, as it sometimes happens that the gun remains up, owing to friction in the ram gland while the pump is drawing the supporting liquid from under the ram; in which case the gun suddenly falls with violence, and damage is done. If therefore the gun does not fall at each stroke, it should be hauled back with tackle, pumping meanwhile being continued. In those mountings which have the suction pipes of the lowering pump entering the top* of the cylinder, the pump as a rule will not begin to act until the top plug has been opened sufficiently to release any air at the top of the cylinder. This plug should not be unscrewed too far, or it may blow out and let down the gun. When the pumping down is finished the pump handle should be removed.

Pumping down is generally made easier by attaching ropes to the handle on either side, on which the Nos. may pull instead of working direct on the handle.

If any leak is discovered, it should be dealt with before the gun is fired as described in the instructions for care and preservation (see below). If no leak is observable the firing may commence.

After first erecting, the firing must commence with a $\frac{1}{2}$ charge (with projectile), the recoil on the ram being carefully noted.

The recoils, measured on the ram, should not exceed—

$\frac{1}{2}$ charge, recoil 21 inches
Full " " 45 "

If the recoil appears too great with the smaller charges, the valves must be adjusted as described below. As a rule the recoil with full charge may be short of the amount shown above, and care must be taken that the elevator does not come hard down upon the buffers when recoiling, as there is danger of the gun fouling the crosshead or front transom of the elevator. Different marks of gun have different outlines; in mounting the gun for the first time, therefore, the clearances there should be looked to. The mountings are designed to bring the gun (with full recoil) to a constant elevation which is unaffected by the position of the elevating arcs, and the heights of the buffers is intended to be so regulated as to give this position; but in practice these conditions are not always obtainable, and the buffers should not be looked to as a guide. The "down" position, as defined above by measurements on the ram, is the proper outside limit of recoil, and it should bring the elevating rods to their "dead centre." But even this condition is not always attained, and it should be borne in mind that it is the *worst* position of the elevating arcs when the gun is "down" that must be looked to in checking the clearances.

* This was done with the idea of the pump first pumping back any air that had accumulated in the ram cylinder into the air cylinder, and not allowing it to blow off through the valve Q. The valves of the lowering pumps are not always delicate enough to pump air, and the valve Q must be opened.

The position of the elevating band on the gun is of importance in connection with this (and also with reference to the accuracy of the graduations on the arc), and this position should be checked. The distance of the centre of the pivots from the centre of the trunnions should be as follows:—

Perpendicular to gun axis—
17 inches.

Parallel to gun axis—
70 inches.

INSTRUCTIONS FOR CARE AND PRESERVATION.

I.—Adjustment of Recoil Valves. (Fig. I, Plate XVII.)

When the recoil obtained is not satisfactory, it is adjusted by altering the play of the recoil valves.

No permanent alteration should be made in the pressure laid down, which should always be worked to; but care should be taken that the pressure indicator is giving the correct record; this can be tested by the dead weight test gauge supplied.

In case of emergency extra pressure may be pumped in to check a tendency to excessive recoil, should such develop itself, and it is desirable to continue firing, but steps must be taken on the first opportunity to enable the service pressure to be resorted to. Loss of liquid will affect the recoil, and the liquid level must always be maintained. No definite effect in checking the recoil need be expected by any change of pressure under 100 lb. per square inch.

The recoil valves are situated inside the cylinder at the bottom, and to get at them the pressure must be let out at the filling plug, or water level cock, and the bottom plugs removed which bear the head of the valves.

It is not necessary to remove the valves except to renew the leather or clear them of grit in case of a leak.

N.B.—All valves are set before the mounting is issued, *they should not be altered unless absolutely necessary.*

When once adjusted for a particular charge, mark of gun, and nature of liquid, any continuance of abnormal recoils will probably be due to incorrect air pressure, and the accuracy of the indicator or the liquid level must be suspected first; at the same time an alteration may have taken place in the condition of the valves, necessitating an altered setting; before an alteration is made under these circumstances, the valves should be carefully examined, and anything calling for remark reported.

To adjust the valve, unscrew the keep screw (*a*), (Plate XVII), turn the nut (*b*) until the keep screw comes opposite to the next slot in the spindle, and screw in the keep screw. Detailed information as to the difference made in recoil is stamped on each valve, together with the amount of the normal lift of the valve with which it is issued. This is necessary as a datum, since the adjusting nut can be turned round till it comes off. If it becomes necessary to remove this nut, the opening allowed to the valve after resetting should be measured. The actual amount of lift given is best measured by filing down a slip of metal till it fits the gap left between *b* and *a* where the coils of the spring give access, and then measuring the thickness of the slip.

After any alteration or adjustment of the recoil valves, the firing must commence with a $\frac{1}{2}$ charge as stated above.

II. Adjustment of raising Valve and repacking its Gland.

(Plate XVII, Fig. II.)

The gland of the spindle of the raising valve can be repacked without blowing out the compressed air from the recoil cylinder. If however there is a leak from the outer chamber to the inner through the raising valve itself, the pressure must be let out before the valve spindle (a) or its seating can be looked to.

To repack the gland, fasten the elevator down by the clips, and take off the nut (e) on the end of the valve spindle. Remove the stop nut from the end of the rack (f), pull out the rack, and remove the bracket (g) and toothed wheel (d) from the valve spindle. The gland nut (c) can now be unscrewed, and the gland repacked, care being taken not to disturb the gland box (b) unless for the purpose of replacing the leather packing (l), when the pressure must be let out and the gland box screwed up again before the packing of the gland commences. In doing this care should be taken not to use too much force, as the gland box is rather weak. In replacing the gland nut it should not be more than a quarter of an inch from "home."

Replace the toothed pinion bracket and nut, pinch the top of the pinion round from left to right until it can be moved no longer (taking care that it is not bearing against the gland nut), which will show that the valve is bearing on its seating; then pinch it back sufficiently from the right to left, drop in the rack, and screw in the stop at the end of it; connect up the link in the cut-off shaft to the top of rack. Replace the cover of the bracket, release the holding down clips of the elevator, and let the gun rise carefully. When the gun is "up," readjust the cut-off chain.

III. Leakage.

Leakage may be internal or external; if the former, it will probably show itself in a tendency of the gun to rise without opening the raising valve; if external, a dripping will generally betray its whereabouts.

Internal leaks may occur at (1) the seat of raising valve, (2) the recoil valve (generally from grit), (3) the leather joint of recoil valve.

If there is loss of pressure with no sign of dripping, the most probable place is the water level cock; but the leak may be into the ram at the bottom plug. The gun must be skidded up to examine this, and the ram withdrawn and examined to ascertain if it contains water. This leak will only occur during firing, or when the weight of the gun is on the ram.

If it is necessary to renew the leather joint of a recoil valve or bottom plug, or examine a recoil valve, the pressure must be let out. In order not to waste any liquid in doing this, disconnect the nozzle of the pipe leading into the metal plug in the bottom of the cylinder, when most of the liquid can be caught in pails, then carefully remove the centre cover valve recoil, putting a pail under it to catch the remaining liquid.

Recoil Ram Gland.—If any considerable leakage occurs at the top of the cylinder, it should be stopped at once—if allowed to continue,

the recoils will soon become too great from loss of liquid. When the gland is in proper working order there should be no leak at all. By noting where the liquid issues, it will be known whether to screw down the gland or cylinder cover. Too much force cannot be applied. Lengthening levers are required on the spanners, and if the spanners are found too weak they should be returned and fresh ones demanded. If the gland will not hold the pressure, it must be repacked with an extra layer of packing.

This packing, when in good condition, is generally sufficient of itself to prevent escape past the ram without the assistance of the L leather below it, and it is comparatively easily renewed. But if it becomes necessary to renew the leather, the ram must be detached from the crosshead.

Before removing the gland the gun must be raised and *skidded up*. The safest plan is to place suitable skidding across the opening of the shield, and pump the gun on to it. A more expeditious method, and attended with less exposure, is to strut the cheeks of the elevator with skids placed against the buffer brackets; but this must be undertaken with every precaution to prevent the skids slipping.

When it is necessary to detach the ram from the crosshead secure the cylinder by lashing to prevent it swinging when free (or the pumping gear, &c., will be damaged), and remove the nut on top of the crosshead. In the 10-inch the cylinder is top heavy; arrangements must be made accordingly.

When the nut is off, and the weight of the cylinder properly taken by the lashing, &c., the ram can be pumped down by the lowering pump. When it is clear of the crosshead, the cylinder cover can be removed and the leather replaced from store. Lifting loops are supplied to raise the cylinder cover and the metal ring over the packing. The former are also available for the capsquares of the mountings. Great care should be taken in putting in a L leather to see that the edges enter properly without being damaged. After replacing the gland and packings, open the raising valve gently, and the ram should then enter the crosshead again, when it may be secured by the nut. Allow the gun to rise, and remove the skidding.

The rope packing is the Service "hydraulic;"* it is woven square in section, with rubber core, and supplied by length. For use, it is cut into lengths so as to form rings (with the ends abutting), which will just enter the gland box. Not less than five are required to form a packing, which are inserted one above the other so as to break joint. The packing should be well greased with hot tallow before use.

If, from remaining long in store, the L leathers become at all shrunk, they should be placed in lukewarm water to expand them before being put into the mounting.

As regards leakage at the ram gland, it should be observed that this should only occur while the gun is in motion, or with the weight resting on the ram. If it happens *continuously* while the gun is resting on the buffers, it will either be because the raising valve does not close, or because the recoil valves leak. If opening the top plug or forcing over the lower of the raising valve does not stop the leak at the gland, the fault may be with the recoil valves; in either case there will generally be a tendency for the gun to rise, and tightening

* Asbestos packing should not be used, it is too friable.

up the ram gland above will of course not stop the internal leak, which should be seen to.

When the recoil and raising valves are working properly, the best way to test the packing of the ram gland is to fasten the gun down by the holding down clips, and open the raising valve, when any escape will become apparent. The same test applies to the air plug in top of cylinder, which before firing should be screwed home, and be airtight.

Without these precautions an escape of air at the top of the cylinder during firing is likely to be missed, and the pressure be lost unawares.

The lowering pump has a gland at each end, and a piston with packing. To pack the piston the parallel link must be disconnected, and the upper guide bracket of pump rod removed. To renew the leather of the upper gland, the upper end of the piston rod must be unscrewed; in doing this, the rod should be held by the hexagon, and the upper end turned, so that the piston may not be turned in the pump cylinder.

The three pump packings can be attended to without blowing the air out of the recoil cylinder, provided the gun is down on the buffers, as there is then no pressure in the pump, the weight of the gun being taken by the buffers, and not by the recoil ram. To make sure that the pressure is removed from the ram, open the air plug at the top of the cylinder. The pressure from the air chambers of the recoil cylinder tends to shut the delivery valves of the pump, so that pressure should not pass to the pump except as with the ram gland, but the fact that these valves themselves may leak should not be lost sight of. Any leak from the pump or its connecting pipes should carry liquid with it.

IV. General Directions.

The efficiency of the mounting depends to a large extent on preserving the leathers in good order. The cylinder should therefore be kept filled with the proper charge of liquid, and under the full working pressure, and the gun slightly raised so that the weight is taken by the ram and not by the buffers.

All spare leathers should be kept in store and rubbed occasionally with dubbing to prevent their becoming hard and brittle. The supply of spare leathers should never be allowed to run low.

The plugs and covers closing the air chambers of the cylinder and the recoil valve should be removed about once every six months, and the cylinder and valves cleaned thoroughly before they are replaced.

If the carriage is to be kept in store for some length of time, it is worth while to pump in a small quantity more liquid, so that it may cover the level cock. There is then less likelihood of escape.

To keep the traversing gear in working order, the most important point is to see that the lower roller path is kept perfectly clear of dirt and fragments. If it has been well cleaned when first erected, there is very little chance of anything falling on it after it is closed in, if ordinary care is taken whenever the foot plates are removed.

The axles of the rollers and the bearings of the shafts of the rest of the gear will require periodical cleaning and lubricating in the manner laid down in Army Form G. 907.

The traversing and elevating gears are to be taken to pieces every six months by the Ordnance Artificers.

The elevating gear should be tried to see that the equalising friction brake is working properly, which it will not do if oil gets on the drum. The friction cones or plates should be *slightly* oiled to prevent scoring. The gun trunnion bearings should be well oiled.

The parts left bright at issue should be kept greased and not painted.

The position of the oil holes are:—

Elevator trunnion	..	..	..	..	2
Crosshead ..	..	..	..	..	2
Cylinder ..	..	..	..	..	2
Bearings of elevating shaft, 1st motion	..	..	..	..	2
" " " 2nd "	..	..	..	..	2
" " " 3rd "	..	..	..	..	2
" " shaft raising valve ..	..	..	..	..	2
Bearing shaft, lowering pump, 1st motion	..	..	..	..	2
" " " 2nd "	..	..	..	..	2
Brackets, traversing gear (2)	..	..	..	..	6
Connecting rods (2)	..	..	..	..	2
Roller axles (each)	..	..	..	..	2

The positions of the leather washers forming joints are:—

Gland or cover of cylinder	..	..	..	1
Raising valve	..	..	..	1
Air plug	..	..	..	1
Lowering pump	..	..	..	5
" connecting pipes (each)	..	..	..	2
Filling cock	..	..	..	1
Bottom plugs (each)	..	..	..	1
Recoil valves (each)	..	..	..	1

The positions of hemp "hydraulic" packing and their sizes are:—

Lowering pump ..	No. 2	..	Size $\frac{3}{4}$ inch square, 75 inches long
Raising valve ..	" 1	..	" $\frac{3}{4}$ " 32 "
Ram gland ..	" 1	..	" $\frac{3}{4}$ " 20 feet "

all of these are in contact with liquid, except the air plug.

Metal joints required to hold pressure occur at:—

1. The water level cock.
2. The raising valve.
3. The recoil valves.
4. The filling cock.
5. Lowering pump valves.

INSTRUCTIONS FOR CARE AND PRESERVATION OF CARRIAGE, GARRISON, DISAPPEARING, MARK III.

All bright parts must be kept clean and slightly greased; all working parts must be regularly and thoroughly lubricated through the holes drilled for the purpose, care being taken to replace the covering screws where these are provided.

The racers and trucks must be kept free from dirt, and the tracks must run freely on their axles; to secure this, the axles should be withdrawn from time to time, and well cleaned and oiled before being replaced. Only one axle should be taken out at a time.

All glands and joints in the main recoil cylinder and in the axial recoil buffer must be kept tight. In the event of it being necessary to renew the packing in either of the stuffing boxes of the main

buffer, the gun must be raised and blocked up at such a height as will allow of the defective packing being removed, the run up valve must be screwed hard down, the gland unscrewed and slid back, the old packing removed, and new packing, thoroughly saturated with Russian tallow, put in its place, care being taken to lay it evenly all round the ram. Screw the gland tight down on the packing.

If the leather round the inner ram requires renewal, it will be necessary to dismount the gun, to remove the steel pipe at the side of the slide, and to disconnect the ram from the crosshead. Before this is done great care must be taken to see that the run up valve is closed. Both glands must then be removed from the outer ram and the new leather passed over the end of the inner ram, care being taken to preserve the edges of the leather from injury. Replace the glands, and screw them firmly down. During this operation some liquid will be unavoidably lost from the axial recoil buffer; this must be replaced before lifting the run up valve.

The packing round the piston rod of the axial recoil buffer can be renewed while the gun is in the firing position, the gland being unscrewed with the short spanner provided for the purpose, the handle of the spanner being struck with a hammer if gland is very tight. If the leather requires renewal the gun must be run up into the firing position, and securely blocked up by the crosshead in such a manner that the slide will be free to turn. Screw the run up valve hard down. Slack back the glands and open the air screw; the liquid will now leak away, and can be caught in any convenient vessel. To remove the nut securing the piston rod to the top cradle, the gun must be set to extreme elevation and hauled back. After the nut is removed the gun must be depressed and run forward, leaving the piston rod in the buffer, when the leather can be passed over the end of the rod and replaced. Care must be taken to re-secure the piston rod, and to refill the buffer, and tighten the air screw before opening the release valve.

To renew the U leathers at the junction of the connecting pipes with the main buffer, it will be necessary to remove the pipes, take off the nut at the top of the inner ram, and withdraw the ram from the crosshead. The leathers on either side can then be easily removed and replaced. Replace the ram in the crosshead and the connecting pipe. The instructions above, with regard to the run up valve and refilling the axial recoil buffer, apply also in this case.

To charge the buffer, place a rod graduated in inches down the pipe at the top of the air chamber, set the gun to extreme depression, open the air screw at the top of the axial recoil buffer, open the run up valve, connect the charging pump to the bottom of the air vessel or the buffer, as may be most convenient, and pump in liquid until it begins to overflow at the air screw.

Close the air screw, and pump in a further quantity of liquid until the rod in the air chamber has risen 2 inches, close the inlet valve where the pump delivery pipe is connected, disconnect the pipe and connect it with the top of the air vessel, pump in air until the pressure rises to 690 lbs. per square inch. Disconnect the delivery pipe and couple it up to the bottom of the air vessel, pump in liquid until the gun rises to the firing position, and immediately this is attained cease pumping. During these operations the rod at the top of the air vessel should be carefully watched, and if its rise shows a depth of less than 1 inch in the hole, more air must be pumped in at the top of the air chamber. When the gun has just reached the

firing position, $32\frac{1}{2}$ inches of the rod should be in the hole in the chamber. Finally, connect the suction pipe of the pump with the bottom of the recoil cylinder, close the run up valve, and pump the gun down; close the inlet valves and disconnect the pump. If the gun is to be left down, it must be secured by means of the holding down shackles and brackets on either side of the main links.

The following has been found by trial to be the time taken and facility in filling the cylinder, by direct pumping and from reservoirs, with the gun held down and free to rise respectively:—

By pump.

Gun held down.

Time of pumping up to 1,600 lbs., 12 hours 4 minutes.

Gun free to rise.

Time of pumping up to 1,600 lbs. and pumping down again, 12 hours 3 minutes.

The above eight men's continuous work.

By reservoirs.

Gun held down.

Nine reservoirs at 2,000 lbs., time 1 hour 40 minutes.

Gun allowed to rise.

Seven reservoirs at 2,000 lbs., time (with pumping down again), 1 hour 40 minutes.

If the recoil fails to bring the gun down into the loading position, the lift of the recoil valves must be increased. This must be done gradually until the correct recoil is obtained, care being taken not to increase the lift by too great steps. If the gun comes down too violently the lift of the recoil valves must be decreased.

In running the gun up into the firing position, the valve should be lifted slightly, and the grasp of the hand on the hand wheel should be retained to control the speed of the lift and close the valve as the gun approaches the firing position, in order to bring it gradually to rest.

The elevating and traversing gears should be examined at least once a month, the teeth of the wheels should be greased and the bearings lubricated with oil. The gun should be elevated and depressed, and the mounting traversed right and left to see that all the gear is in good order and working smoothly.

The elevating screws especially must be kept clean and well greased, and the gear wheels free from dirt.

The pump for the hydraulic pivot must be examined from time to time, to see that the leather packings round the plungers are in good order, and that the valves fit well upon their seatings and are working freely. The liquid supplied to the hydraulic pivot must be kept clean and free from grit, and in the event of the ram being withdrawn from the cylinder, it and the cylinder must be carefully protected from abrasion.

If it is found that the delivery of the pump while traversing is not sufficient to counteract the leakage and support the carriage, the crank and eccentric must be adjusted so as to work more nearly together. This can be done by removing the bolts in the flanged coupling, turning the eccentric through the required angle, and recoupling. The height to which the carriage is lifted can be seen by the pointer fitted for the purpose.

The leather packings and the valves of the charging pump must be frequently examined and kept in good working order. The pump will work equally well in whichever direction the hand wheels are turned.

When pumping against a low pressure the cranks should be together to give the maximum delivery. As the pressure rises and the work gets harder the cranks should be shifted step by step until they are as nearly as possible opposite, to give the maximum pressure.

DESCRIPTION OF THE "PUMP, AIR, DOUBLE, CARRIAGE, GARRISON, DISAPPEARING, MARK I."

(Plates XVIII and XIX.)

The pump is intended to charge the recoil cylinders of disappearing garrison mountings with fluid or compressed air.

It consists of two gunmetal cylinders (A and B, Plate XVIII,) of different diameters, in one casting, with a base plate, on the top of which an iron frame is bolted to form a tank (C) for the fluid while being pumped into the recoil cylinders. The pump cylinders are fitted with plungers (D) actuated by a rocking lever (E), which is supported on brackets (F) rivetted to the tank.

The pump is in duplicate, and is bolted to an iron bedding plate (G), which is secured to the floor by clips (H) and cottars (I). It is worked by two T handles, which are attached to the rocking levers, and are connected at the top by a link to insure uniform action.

When charging the recoil cylinders with fluid, the fluid is drawn through suction valves from the tank into the large pump cylinders (A), and on the down stroke of the plunger is forced into the small cylinder through delivery valves. When charging with air the connection between the tank and the cylinders is cut off by closing the valves (a) near the copper delivery pipes, and the air is drawn through a suction valve at the bottom of the large cylinder. This valve is never cut off, but is more heavily weighted than the water valve, and when the water passage is open, liquid is drawn in in preference to air, provided the strokes are not too jerky.

Either pump can be disconnected if necessary, and worked independently; the delivery of either is cut off by closing the delivery valve. When this is closed of course the handle must be disconnected, so that the pump cut-off may not be worked.

The pump should be kept in store with the tanks full of liquid, and so used whether air or liquid is being pumped.

To keep the leathers in good order they should be slightly under pressure. To obtain this, screw one length of the copper tubing on the delivery nozzle (J), and on to the other end of the tube fix the blank cap (with packing leather). Then work the pump with the water valves closed until it becomes difficult to move the handles, when the pump may be left—the air in the tubing serving to maintain the pressure obtained.

When standing long in store, the pump should be tried occasionally, to see that the pressure is still on.

RESERVOIR AND SEPARATOR FOR H.P. MOUNTINGS.

(Plate XVIIIa.)

The reservoir is for keeping in reserve a supply of compressed air for re-charging the cylinders of H.P. mountings. It is in the form of a flask, with a short neck at one end, fitted with a stop-cock (a) for charging and discharging the reservoir; the outer end of the cock is screwed to take the nut of the charging pipe, and is protected when not in use by a wrought iron cap (b).

(7953)

The pressure in the reservoir should not exceed 2,000 lbs. on the square inch when in ordinary use, or 1,600 lbs. when travelling.

The separator is to separate the moisture from the air during the process of pumping into the reservoir. It consists of a copper tube, $1\frac{1}{2}$ inch in diameter and 3 feet long, screwed at both ends. At one end of the copper tube a wrought iron head (c) is fitted, furnished with inlet and outlet valves of gunmetal, and a $\frac{1}{4}$ -inch copper pipe (d), which carries the air and water in a downward direction into the separator. At the other end of the copper tube is a wrought iron foot which is fitted with a drain-cock (e) of gunmetal. The separator is connected up between the pump and the reservoir, and the moisture of the air, while passing through the copper tube, falls to the bottom and is blown off from time to time during the operation through the drain-cock. When the separator is used, it must be always fixed in a vertical position, the inlet and outlet valves being at the top.

INDICATOR, PRESSURE, SPRING, CARRIAGE, GARRISON, DISAPPEARING, MARK I.

(Plate XX.)

This indicator shows the air pressure per square inch in the recoil cylinders of H.P. mountings.

It consists of a small gunmetal cylinder (a) surrounded by a steel spiral spring (c), which is contained in a metal casing (d).

In the centre of the cylinder works a steel ram or plunger (e), which is screwed into the top of the casing (f), and the bottom of the casing is formed with a rim, which fits round the cylinder, and acts upon the spiral spring. A pointer (g) is fixed to the top of the cylinder, and a graduated scale (i) is attached to the outside of the casing.

When the indicator is connected to the filling cock of the recoil cylinder, the pressure of the compressed air on the fluid acts on the bottom of the ram (e), and overcoming the resistance of the spring, lifts the top (f) and with it the casing (d). The cylinder, with the indicator, remains stationary, and the upward movement of the casing, with the graduated scale, registers the pressure in the recoil cylinder in pounds per square inch. In taking pressures the reading to which the indicator rises must be taken, and the casing should not be touched. There is considerable friction between the plunger and the cylinder, which is allowed for in the graduating; the indicator will not therefore record a falling pressure, and the pressure should be let on gradually, and not with a jerk. When it is desired to take a second reading, the connection with the cylinder must be cut off, and the pressure released from the indicator before re-applying it.

When not in use the indicator should, if possible, be kept under a pressure of 50 or 100 lbs. This can be done by means of the dead weight test gauge and the connection mentioned below.

The small leather (k) of the plunger must not be touched; if it fails to act, the indicator must be returned into store for adjustment.

CONNECTION, INDICATOR, PRESSURE.

(Plate XXI.)

The indicator is attached to the recoil cylinder of the mounting by the intervention of a three-way connection, one opening of which (a) screws into the filling cock, the opposite one (b) takes the pump tube, and the centre (c) the indicator. (When the indicator

is not on this opening is closed by the closing plug (*f*), the nut (*h*) fitting either the plug (*f*) or the foot of the indicator. (See (*h*), Plate XXII.) There is a cut off (*d*) worked by the spindle (*e*), which closes the way to the indicator, while leaving the passage free between pump and cylinder. The way to the indicator should not be left open while pumping or firing is going on, as the indicator is liable to suffer. When it is desired to leave the indicator on, and detach the pump pipe, the bared nozzle of the connection is closed by a blank cap (with leather washer), supplied.

In connecting the indicator it is not necessary that it should be absolutely vertical, an inclination of 10° or 15° is admissible.

The indicator is issued in a box with two spanners.

INDICATOR, PRESSURE, SPRING CARRIAGE, GARRISON DISAPPEARING, MARK II.

This differs from the Mark I in having a larger piston and a stronger spring, the motion of the plunger being multiplied by a chain and drum moving a hand on a circular dial. There is no leather on the piston, its place being taken by a recess with packing. The packing to be used is asbestos fibre finely shredded, and mixed with tallow; this is issued in a tin box with the indicator, and no other packing is to be used.

The indicator is issued in a box with the necessary spanners, packing, and instructions. It is much more sensitive than Mark I and will record both a rising and falling pressure with accuracy.

GAUGE, PRESSURE, DEAD WEIGHT TESTING, MARK I.

(Plate XXII.)

This is issued to test the accuracy of the indicator records.

The indicator is screwed on to the connection at one end, and fluid pressure applied by means of a plunger (*d*) driven by a hand-wheel (*h*) at the other end. A safety valve, weighted with marked weights (*w*), releases the liquid when the pressure per square inch marked on the weights is obtained; the indicator (*m*) should then show this pressure.*

The liquid employed is a mixture of equal parts glycerine and distilled water, which is poured into the reservoir (*g*) from time to time as required. There are two cut off valves (*b*) and (*c*), one to the indicator and one to the reservoir. As the stroke of the plunger is small, the liquid has to be drawn from time to time from the reservoir without losing the pressure, and this is effected by the judicious manipulation of these valves, the indicator being cut off by screwing up the valve (*b*) and the reservoir connected when the plunger is being withdrawn, and the reservoir cut off by the valve (*c*) and indicator connected when the plunger is being screwed in. A certain amount of liquid runs to waste from the safety valve (*e*) when the desired pressure is obtained. The reservoir should be kept covered while in use to prevent dust getting into the liquid.

Care should be taken not to shake the instrument while the pressure is on, as it is liable to make the safety valve act prematurely, and so vitiate the results.

There are several leather joints and packings which require

* It should be noted that the bed plate, etc., for the weights, counts for 200 lb. (per square inch) in addition to the weights applied.

attention. Spare leathers are issued in a small tin box in the case, together with the necessary spanners.

GAUGE, PRESSURE, DEAD WEIGHT TESTING, MARK II.

This has the body of the Mark I gauge, with a piston with packing similar to the indicator Mark II. The area of the piston being enlarged from Mark I, the motion is controlled by a lever, to which the weights are hung.

The manipulation is the same as the Mark I, but there is no escape of liquid. The liquid to be used is the same as that employed in the cylinders of the H.P. mountings.

Special instructions are issued with the gauge (as to packing the piston, &c.) or with the fittings when issued for the conversion of Mark I.

AMMUNITION.

PROJECTILES.

(Plates XXIII to XXVI.)

Shell, common, bursting charge, 37 lb. 12 oz. P and F.G.	} 500 lb.
" Shrapnel " " 1 lb. 9 oz. F.G. ..	
Shot, Palliser	
" Armour piercing	

DESCRIPTION.

COMMON SHELL.

The shell is made of steel, cast with bands, turned to a diameter of 9.95 inches. The base of the shell is rounded with a radius of .2 inch. The head is struck with a radius of two diameters, the point being truncated, screwed, and fitted with a gunmetal bush, tapped to G.S. fuze hole gauge. The interior of the shell is lacquered.

A groove is turned in the body near the base, into which is pressed a copper driving band, turned to a diameter of 10.145 inches, to impart rotation to the shell.

A hole is bored in the side of the shell, opposite the centre of gravity, and screwed to receive an eyebolt for lifting purposes, so that when lifted the shell will be horizontal.

The base of the shell is bored and screwed 9 threads per inch, left hand, and fitted with a gunmetal adapter, the joint being made gas tight by a lead ring. The adapter is screwed inside 9 threads per inch, left hand, to take a gunmetal plug having a square keyhole in the head, and a lead washer under it to form a gastight joint.

SHRAPNEL SHELL.

This shell has a body of cast steel, cast with bands, 9.95 inches in diameter. The fitting of the driving bands is exactly similar to that of the common shell, and there is also a lifting hole at the centre of gravity. The top of the shell is closed with a wooden head covered with steel, and secured by rivets and twisting pins, the head being provided with a fuze socket of the usual pattern. The bursting charge is 1 lb. 9 ozs. F.G., and the shell contains 400 (4-oz.) sand shot.

PALLISER SHOT.

The head is cast in chill, and the body in sand. The head is struck with a radius of two diameters, and the base is rounded with

a radius of .2 inch. The cavity, which is not intended to contain a bursting charge, is closed by a cast iron plug secured with lead. The shot is fitted with the broad Vavasseur driving band, having three cannelures, and hole for the lifting eyebolt, the same as the common shell. The dimensions are:—

	inches.
Length over all	30.56
Diameter over body	9.8
" " bands	9.95
" " driving band	10.145
Weight	500 lbs.

SHOT, ARMOUR PIERCING.

This is of forged steel, externally resembling the Palliser shot. It has a core (the size of which is left to the manufacturer) in order that a burster may be inserted, should one be hereafter decided on. The base is closed by a screw plug. The weight of the shot is 500 lbs., and is calculated to pierce 16 inches of compound armour at 100 yards range.

PAPER SHOT.

Mark I is made up in two parts, each part consisting of a cylinder of rolled brown paper, choked at top and bottom to elm wood discs, the bottom disc being weakened by holes partially bored through it so that it may break up on firing.

The total weight of the shot is brought up to that of the service projectile by each cylinder being weighted up to 250 lbs. with No. 5 small shot and sawdust, the filling being done through a hole in the top disc, which is then closed with a wood plug.

The cylinders forming a shot are marked "Front" and "Rear," and are used as their names imply. The part marked "Rear" has its bottom disc larger in diameter than the bore, and is in consequence stopped on ramming home when its rear end reaches the commencement of the bore in order that the shot may not be rammed home too far.

Mark II differs altogether from Mark I in appearance and construction. The cylinders are made entirely of papier-mâché, of a hard, black, polished surface on the exterior, ribbed discs of papier-mâché taking the place of the wood discs in Mark I. The method of filling and the enlargement of the base of the rear cylinder are, however, the same as in the Mark I.

As they break up on firing, the small shot travel but a short distance (about 200 yards), while the effect, for purposes of testing recoil, &c., is practically the same as that obtained with the service projectile.

They will, therefore, be shortly issued for use in time of peace for such purposes as those laid down in Army Order No. 364, para. 5, dated October, 1890, and in similar cases where the use of a service projectile would be dangerous or inconvenient, as for instance on a range over a harbour or channel much frequented by shipping.

There will, no doubt, be emplacements from which, owing to the close vicinity of houses, it may be undesirable to use these shot in the normal line of fire. In these cases it will often be found possible, owing to the very short range of the paper shot, to find sufficient space to the right or left of the regular range to carry out such test practice as may be required.

DRILL SHOT.

This is of cast iron, fitted with two copper bands to prevent injury to the rifling in loading and unloading. The nose is bushed with gunmetal, and the base is fitted with a large hollowed and flanged nut of gunmetal, with a groove to take a rope grummet, which prevents the shell being rammed too far home.

INSTRUCTIONS FOR FILLING SHELL.

COMMON SHELL.

These shell are filled with a mixture of P. and fine grained powder. The fine grained powder selected for this purpose will be shell F.G., and on emergency service L.G., Pistol, F.G., R.F.G., or R.F.G.²

To fill the shell:—Stand it upon its point, after inserting a G.S. plug; pass the "Holder, shell, B.L.," over the base, and screw up the bolt. Unscrew the plug by the "Wrench, base plug," then unscrew the adapter, having first cut out the lead ring, if there is one, and having searched, and if necessary up-ended the shell, drop in three "Bags, primer, filled, 7 drs." Place the brass filling rod inside the bag, and insert it in the shell, taking care not to push the rod through the bag, and withdraw the rod.

Weigh out the bursting charge in proportions of about 4 lb. P. and 10 oz. F.G.; drop one portion of P. powder into the shell, pebble by pebble, then insert the funnel, and pour in the required quantity of F.G.

The mixture is then lightly stirred and pressed with the filling rod, and the operations repeated until the shell is filled, when the neck of the bag is tied up. It is passed through the adapter, which is then screwed home, and the neck of the bag is cut off, and the bag pushed into the shell and the plug screwed in. A new lead ring will then be hammered into the recess round the adapter.

Weight of bursting charge, 32 lbs. 12 oz. P. to 5 lbs. F.G. Total, 37 lbs. 12 oz.

SHRAPNEL SHELL.

Remove the plug from the fuze hole, and after seeing that the fuze hole is clear of any dirt, &c., insert the funnel and pour in the bursting charge (Service Pistol, F.G., R.F.G., or R.F.G.²), which has been previously weighed or measured. This must be done gradually, or the tube is liable to get choked. The shell should be tapped on the side with a wooden mallet until the whole of the bursting charge has passed down the tube, care being taken that none is left at the bottom of the socket. Drop in the "Primer, Shrapnel shell, Mark III," and screw it tightly into the tube with the "Driver, screw, Shrapnel, large, Mark III." Then screw in the fuze or plug, as may be required.

FIXING PLUGS AND FUZES, AND SECURING SHELLS.

When plugs or metal fuzes are screwed into shells, they will be lubricated with Price's composite grease.

Filled B.L. common shell loaded through the base have the lead ring hammered flat in the recess provided for it, and this ring and the adapter painted over with black paint.

Empty projectiles fitted with plugs and kept in exposed situations, where the plugs are liable to become set fast by corrosion from the action of salt water, or otherwise, should have their plugs unscrewed once at least every six months, and the threads cleaned and re-lubricated as above.

Instances have occurred in which fuze hole plugs of common shells have been so jammed in as to be immovable, in consequence of using the "Wrench, base plug." The "Key, fuze and plug, G.S.," the "Key, plug, G.S.," or the "Key, fuze, universal," are the only implements which should be used for screwing in the G.S. plug.

DISTINGUISHING MARKS.

All Shrapnel shell will be painted with a red tip 1 inch deep.

All steel shot or shell will have a white band $\frac{1}{2}$ inch wide painted round the head 1 inch from the top; in the case of Shrapnel this white band will be immediately below the red tip. C.S. will be stamped on the base of cast steel, and F.S. on the base of forged steel projectiles.

Filled shells will be marked in red, as follows:—

- (a). A band $\frac{1}{2}$ inch wide, $1\frac{1}{2}$ inch from the top. In the case of steel shell this will come just below the white band.
- (b). The word "bag" if one has been used.
- (c). The monogram of the station, except when filled by the Royal Artillery.
- (d). The date of filling.
- (e). A $\frac{3}{4}$ disc, 1 inch diameter, if shalloon primer has been inserted.
- (f). The letter P, $1\frac{1}{2}$ inch long, if filled with P and F G.

The size of the type, except the letter P, will be $\frac{3}{4}$ inch. Stencil plates will be made locally, except those for marking the red or white band, which will be demanded, the exact nomenclature and numeral of the shell being stated on the demand.

Projectiles which are to be used for practice only will be marked with a yellow band $\frac{1}{2}$ inch wide round the body.

Shells which have been emptied will be marked with the letter E and the monogram of the station, in red paint.

Armour-piercing shot when weighted up to mean weight with small shot and sawdust, have W. stencilled on the head in white paint, and stamped on the base plug.

EXAMINATION OF SHELLS.

COMMON.

Remove the base plug, draw out the neck of the bag by means of the Hook, G.S. wad, and untie the twine round the neck. If the powder is in a serviceable condition, tie up and replace the neck of the bag and screw in the plug. If the powder is found to be caked from the effects of damp, the shell will be returned into store to be emptied.

SHRAPNEL.

Remove the fuze hole plug, unscrew the primer with the "large screwdriver," and lift out the primer with the "pincers, Shrapnel primers;" turn the shell nose downwards, and if the powder charge flows out and is serviceable, refill and insert a new primer and replace the plug. The old primer will be tested. If the powder is damp or does not flow out, the shell should be returned into store to be emptied.

STORAGE OF FILLED SHELLS.

Filled shells will as a rule be stored on their bases. In exceptional cases, however, where it is desirable to utilize existing accommodation, which will not admit of the shell being so stored, they should be piled as may be found most convenient, a board being placed for the bottom layer to rest upon just in front of the driving band, and each layer pointing in the opposite direction to the one below, with the driving bands clear of the projectiles in the layer below, to prevent injury to the former.

AUGMENTING STRIPS.

DESCRIPTION AND METHOD OF INSERTION.

Augmenting strips are intended to be used with B.L. projectiles in cases when the rifling of the gun has, owing to erosion, become so worn that the gun ceases to properly rotate its projectiles. The strips are of copper, of even section throughout, and grooved on one side. The lengths of the strips vary with the calibre, and they are marked for the nature of the gun with which they are intended to be used.

Method of Insertion.

The top cannellure in the driving band is to be undercut all round on both sides by means of a special chisel supplied for the purpose. The augmenting strip is then inserted in the cannellure, grooved side of strip inwards, and lightly hammered until the two tongues of metal formed by the groove on the inner side of the strip are dovetailed into the undercuts in the cannellure.*

If the gun is very much worn, and one strip is found insufficient to impart the proper rotation, a second may be inserted in the lower cannellure in addition.

The number of rounds which may be fired from the 10-inch B.L. gun before augmenting strips must be used is (probably) 162.

As regards wear of the bore, reduced charges may be reckoned to have a quarter the effect of full charges.

NOTE.—In future all B.L. projectiles 9.2-inch and upwards will be made with the front bevel of the driving band grooved as shown in the plates. 10-inch projectiles without grooved driving bands will be altered locally where the necessary lathes are available, instructions and tools being supplied on demand. Where this cannot be done, the projectiles will be returned to Woolwich for alteration.

* Cannellures will in future be undercut during manufacture, and the shell will then be marked with a U on the driving band.

FUZES.

(Plate XXVIII.)

Percussion, Direct Action, No. 3, Mark III.

Time, Sensitive, Middle, No. 24, Mark I.

FUZE, DIRECT ACTION

Mark II fuze is made of gunmetal, turned all over, and screwed below the head to suit G.S. fuze hole; the interior is bored out at the lower end for the powder charge, and screwed to receive base plug; the upper part of fuze is charged with detonating composition, over which is a brass disc .005 inch thick, and the holes communicating with magazine filled with powder priming; the fuze is fitted with a steel needle passing through and secured in a copper suspending disc .032 inch thick. The lower part of the fuze is filled with pistol powder, and covered with a disc of shalloon.

Mark III is identical with Mark II internally, but is screwed throughout its length externally. It is closed at the top with a left handed screw plug, instead of the cap as in Marks I* and II. This enables it to be screwed into the shell before issue for S.S.

Mark III is to be used on sea fronts only, and this Mark only will therefore be used with this gun. Marks I* and II are to be used on land fronts and with siege train.

The Mark III fuze requires no preparation except the removal of the plug; the fuze is screwed firmly into the fuze hole by the "Key, fuze, universal." The plug is not to be removed until just before entering the shell into the breech of the gun.

On striking any object the suspending disc is driven in, and the needle is forced against the detonating composition, thereby exploding the fuze.

FUZE, TIME, SENSITIVE, MIDDLE.

The fuze consists of the following parts:—

Body (a) with stem, lighting pellet (b), two retaining pellets (cc), two spiral springs (dd), needle (e), composition ring (f), dome (g), cap (h), two safety pins (ii), base plug (k), and axial magazine filled with M.G.¹ powder (l).

All the parts are made of gunmetal.

The composition ring is graduated on its periphery from 0 to 30, and reads to quarter units. An ↓ is stamped on the ring to show the safety point, and when this coincides with the ↑ on the body the fuze is set at safety. The cap, which screws on to the top of the stem, is made hexagonal, to fit the "Key, fuze, universal."

The fuze is set by loosening the screw cap (h) on the top of stem, by means of the "Key, fuze, universal," and turning the dome and

ring till the required graduation on the latter coincides with the arrow head on the body; then tighten the screw cap. The safety pins are withdrawn at the moment of loading. On discharge the centrifugal action causes the retaining pellets to fly out, releasing the lighting pellet, which flies by centrifugal force against the needle, firing the detonator, which ignites the powder in the pellet and axial magazine, this latter lighting the quick match in the composition ring.

Weight	..	..	..	..	..	1 lb. 4 oz.
Time of burning at rest	..	..	..	..	..	14.8 to 15.4 secs.

CHARGE.

FULL.

252 lb. Prism¹ brown, in four $\frac{1}{4}$ cartridges.

CARTRIDGE.

(Plate XXX.)

B.L. 10-inch, 63 lb. Prism¹ Brown.

The cartridge is made of No. 3 class silk cloth; the body is prismatic, with polygonal ends shaped to fit the form of the built up prisms. In the centre of each end there is a hole 4 inches in diameter, covered with silk netting, over which the shalloon disc is fastened by shellac; a piece of broad silk braid is sewn on to each shalloon disc for the purpose of tearing it off before loading.

Two beackets made of silk braid $1\frac{1}{2}$ inches wide are sewn on the top and bottom for the purpose of lifting the cartridge. It has also eight 65-inch silk braid hoops, which keep it in form, thus making a good firm cartridge.

DRILL CARTRIDGE.

A dummy cartridge is issued for drill purposes. It is made of wood, weighted with cast iron, and covered with raw hide, and is of the same weight and dimensions as the Service cartridge.

INSTRUCTIONS FOR FILLING CARTRIDGES.

These cartridges are made up as follows:—The prisms are built up by hand in a zinc envelope open at both ends, having as many sides, and being of the same length as the finished cartridge, fitted with a movable wooden bottom, secured by three screws; the envelope is placed on a pedestal less in diameter than the wood bottom, and filled with the required number of complete layers of prisms; the empty cartridge is then pulled downwards over the envelope, the screws holding the wood bottom taken out, and the envelope drawn down from between the prisms and silk cloth; the latter is then held down tightly over the prisms while the braids are

being secured, commencing with the bottom braid, hooping being performed as mentioned above. The cartridge is then reversed, and after the wood bottom has been taken out, it is placed on the scales (an empty cartridge being placed with the weights), and the necessary prisms removed from the top layer, until the weight of powder is correct. The superfluous cloth is then cut off to within about 1 inch of the top layer of prisms, a few vertical cuts made in the overlap, which is turned in, and the edge brought flush with the charge. The top is then placed on, secured at each side, and sewn round with two strands of silk twist.

These cartridges, if necessary, may be made up, by careful manipulation, without using a zinc cylinder, by building up the prisms on a wooden bottom cut to the same shape as the cartridge.

The powder is built up in twelve layers, consisting of eleven layers having fifty-five prisms each, and one layer having such convenient number as will bring the total weight up to 63 lb., but the top layer should not contain less than 75 per cent. of the number of prisms in a complete layer, one or more prisms being taken from each complete layer to make up the requisite number in the top layer.

In the centre of both top and bottom tiers seven prisms of Prism¹ black powder are inserted, to facilitate ignition.

The dimensions of the cartridge when filled are to be as follows, viz. :—

Diameter not to exceed	ins.
Length	12
	12.25

MARKING CARTRIDGES

Cartridges are marked with the nature of the powder they contain, the nature of gun, weight and mark of cartridge, and the proportion of the charge contained in the cartridge. A record of powder used in all cartridges, with maker's name, lot, and date of filling will be marked on the package, and will be kept in a book for reference.

All filled cartridges will have the initial or monogram of the station at which they are filled stamped on the bottom end in *black* printer's ink, one inch long. About $\frac{1}{4}$ oz. of ink will be sufficient for 100 cartridges.

The cartridges filled by the Royal Artillery will be distinguished by having no initial letter stamped on them. This order does not apply to cartridges filled by working parties of Royal Artillery for the Ordnance Store Department.

The initials and monograms used at the several stations are given in the Magazine Regulations.

All cartridges will be carefully examined and gauged as to length and diameter previous to packing.

Each quarter charge is packed in a zinc cylinder.



SECURING LIDS, STACKING, AND PAINTING CARTRIDGE CYLINDERS.

Screw on the lid by hand from left to right until the leather washer bears hard upon the top edges of the cylinder, then fasten round the junction of the cylinder and the edge of the lid a tape band about 2 inches wide, well coated with a cement of gum shellac and methylated spirits of a workable consistency: the tape should overlap about 4 inches, and be placed so that the edges may be protected as much as possible by being in the hollows of the corrugations; work the tape (except the end which is turned under, forming a loop 1 inch in length) well into the corrugations with the hand, and, when well set, give the band a coating of thin shellac, and when dry a coat of stone colour paint.

In order to open the cylinder, tear off the tape band, place the cylinder bearer between the lugs, and then give a smart wrench in the required direction. Labels bearing the above directions are pasted on the lids of each cylinder.

Where storage accommodation permits, cartridge cylinders will be stacked vertically in columnar form (i.e., one immediately above the other), each column not to exceed five cylinders. Where the chambers are sufficiently lofty to admit of more than one stack, the second stack will be placed on skidding supported by frames. Care should be taken that the cylinders do not touch the walls during the process of stacking. Where cylinders cannot be stored vertically, they will be piled on their sides, and the number of tiers in each stack will be limited to four.

TUBES.

(Plates XXXI to XXXIII.)

Tubes, vent sealing	{	Electric, P., Marks III and IV. Percussion, Marks II and III. Electric, P., drill, Mark III. Percussion, drill, Mark I.
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The percussion lock arrangement necessitates a special tube for firing the charge, and this tube performs a double duty in sealing the vent when fired so as to prevent the escape of gas. The tubes, both for service and drill, are made of two patterns, for firing by hand or by electricity.

TUBE, VENT SEALING, ELECTRIC, P.

It is made of brass, bored out to receive the arrangement for firing by electricity: the insulated wires, entering through the head, pass through a plug of asbestos and through a conical plug of ebonite; the two ends are soldered into two copper poles, which are connected by a bridge of platinum wire surrounded by a small quantity of gun-cotton dust and meal powder, enclosed in a case or cylinder of thin ebonite, having a thin paper disc over the end; the remainder of the space is filled with loose gunpowder (F.G.). The

bottom end is closed by a paper disc and cork plug in Marks II and III, and by a paper disc and perforated brass ball embedded in sulphur and secured with shellac in Mark IV.

There is a small air space left between the plugs of asbestos and ebonite. On firing the gun, the pressure forces the ebonite plug up the cone and on to the asbestos, thus preventing any escape of gas.

Externally the head of the tube is flat, the insulated wires being laid down in two grooves on the top, as shown in the plate, so as to project sideways. These wires are 18 inches long in Mark II, 21 inches in Mark III, and 22 inches in Mark IV.

The store of Mark III will be first used up.

TUBE, VENT SEALING, PERCUSSION.

This consists of a body, anvil, striker, washer, percussion cap, copper disc, two paper discs, and a cork plug. The body is made of brass, solid drawn; a hole is drilled through the head to receive the striker, which is secured in position by being riveted into the countersunk washer as shown in the plate. The upper part of the chamber is screwed and fitted with an anvil on which is placed the percussion cap, the upper surface of which is in contact with the striker; a small central and two diagonal fire holes are drilled through the anvil. The remainder of the space in the tube is filled with loose pistol powder, and the bottom is closed with a paper disc and cork plug, coated with varnish, in Mark II, and with a paper disc and perforated brass ball embedded in sulphur and secured with shellac in Mark III.

The store of Mark II will be first used up.

On firing the gun, the point of the striker of the percussion lock drives the striker of the tube, together with the percussion cap, on to the anvil, thus firing the tube.

Mark II differs from Mark III in not having the brass ball and sulphur, nor the diagonal fire holes in the anvil.

TUBE, VENT SEALING, ELECTRIC, P., DRILL.

The body of this tube is made of gunmetal in three parts, screwed together and milled outside as shown in the plate. There are two escape holes through the head, and two holes lined with ebonite cylinders, through which the wire terminals pass and project into the interior to form the poles.

These are connected by a platinum silver bridge soldered to them.

The tube is issued empty. When required for use it will be charged with a small quantity of priming composition (§ 2866), the escape holes being lightly stopped with luting on the outside.

Mark II differs from Mark I in having a brass plate fitting into an undercut slot in the head of the tube, and in minor interior details.

Mark III differs from Mark II in having wires 22 inches long instead of 18 inches. Earlier issues of Mark III have wires 21 inches long.

TUBE, VENT SEALING, PERCUSSION, DRILL.

This tube is made of gunmetal, the interior being bored out, and the head fitted to receive the coned indiarubber plug as shown in the plate. The lower portion is closed by a gunmetal plug.

EXTRACTORS.

(Plate XXXIV.)

Two forms of extractor are supplied: the "Extractor tube" P (Mark I), and the "Extractor tube" P "Special (Mark I)." The "P" extractor is a short steel bar shaped like a letter S, and having claw shaped jaws at both ends.

To extract a tube, first raise the lock, and insert the jaws of the extractor under the head of the tube; then using the end of the extractor remote from the tube as a lever, prise up the tube and remove it.

When a tube is too tightly jammed to be removed as directed above, the "P special" must be used.

This extractor consists of a steel sheath containing two jaws, controlled by a revolving cross handle which works in the top of the sheath. The jaws, which are shaped to fit the head of the tube, open and protrude from, or close and recede into, the sheath, according to the direction in which the cross handle is turned. To extract a tube, first remove the lock, then turning the cross handle until the jaws protrude, fit the jaws over the head of the tube. Reversing the motion of the cross handle, the jaws close and nip the tube, and the handle being further turned the jaws recede, forcibly drawing the tube with them.

NOTES.

In the event of a tube failing to ignite a charge, care should be taken in extracting the fired tube not to stand directly in rear of the gun, as the gas generated will cause the tube to fly out with some violence when eased by the extractor.

The vent sometimes becomes choked with residue from the cartridge. It should be cleared with a "rimer, vent, axial," sufficiently to allow of the insertion of a tube, which, when fired, will remove the rest of the obstruction.

Care must be taken to see that the range is clear when using Mark IV Electric or Mark III percussion tube, for clearing the vent or any other purpose than regular practice (in which case the range would of course be clear before firing), as the brass ball is projected with considerable velocity by the powder in the tube.

A tube is not to be inserted in the vent till the breech is properly closed.

INSTRUCTIONS FOR THE MANAGEMENT AND PRESERVATION OF
BATTERY, ELECTRIC FIRING, 3-CELL, LECLANCHÉ.

The battery consists of three Leclanché cells, a firing key, and the necessary connections fitted into a wooden case. The poles are connected, one direct to a binding screw, and the other to the nipple of the firing key, the arm of which is connected to the other binding screw.

In order to preclude risk of accident, the firing key is fitted with a spring safety catch, which must be pulled out and kept out to enable the key to be pressed down.

When supplied the cells are charged with dry sal ammoniac only, and sealed up; the batteries are consequently inactive, and must be

prepared for service by pouring into each cell about a pint of a cold $\frac{1}{2}$ lb. saturated solution of sal ammoniac, prepared by dissolving $4\frac{1}{2}$ ozs. of the salt (crushed) in one pint of boiling water, the sal ammoniac being added gradually till it is all dissolved.

After the battery has been charged and the wires attached, the test bridge is to be applied to the ends of the wires in the same way that the fuzes and detonators are afterwards applied; the cover of the test bridge should then be removed so that the wire bridge may be seen, and if on completing the circuit with the battery the bridge becomes bright red hot, the battery and wires are in a serviceable condition. Should the bridge not become red hot, the insulated wire should be removed and the test bridge applied direct to the terminals. It will thus be ascertained whether the battery or the wire is at fault. The battery must not be expected to attain its full strength until half an hour after it has been charged.

As a Leclanché battery is very liable to become polarised, or "run down" as it is commonly called, by being put on short circuit, and as the effect of this polarisation will, to a great extent, disappear in time, it is advisable before taking the battery to pieces for renovating, if time permits, to leave it for a few days disconnected, testing it every day to see if it is improving.

As no local action takes place in this cell when the circuit is open, the solution when once poured in should not be emptied out again unless for packing, or when it is found that the battery is exhausted and requires a fresh solution.

INSTRUCTIONS FOR THE MANAGEMENT AND PRESERVATION OF THE MENOTTI TEST BATTERY.

The outer vessel is of ebonite, at the bottom of which is a copper cup $\frac{1}{2}$ inch deep and $3\frac{1}{2}$ inches in diameter, containing 2 ozs. of crystal of sulphate of copper, with a "fearnought" diaphragm on top. Above this is 3 inches of fine sawdust that has been moistened with clean fresh water and laid in loosely. On top of this layer of sawdust is another diaphragm, and then a slab of zinc $\frac{1}{2}$ inch thick, $3\frac{1}{2}$ inches in diameter, and weighing 2 lbs. The upper portion of the zinc and its connection with the insulated wire are carefully insulated.

As this cell is only used for testing purposes, a low resistance (about 20 ohms) astatic galvanometer is permanently attached to the ebonite disc which forms the core of the cell, together with a key which closes the circuit through the wires or tube under test. The whole is fitted into a leather case.

The batteries are supplied with the sulphate of copper, fearnought diaphragms and sawdust in place, but dry and consequently inactive. They are prepared for service by taking out the sawdust, soaking it in clean fresh water, or better still in a solution of sulphate of zinc, then squeezing it out to a certain extent and replacing it; the advantage of this method being that the cell will be ready for use at once. If the water were merely poured on to the sawdust, some hours or even days will elapse before the cell is ready for use. If the sulphate of copper is spilt among the sawdust, care should be taken to remove all the spilt crystals or to use fresh sawdust, for if the sulphate of copper is allowed to come into contact with the zinc, it will at once deposit copper on the latter.

(7953)

Test.

After being rendered active the battery should be tested by joining a short wire between the positive pole of the battery and the free terminal of the galvanometer, then placing the instrument so that the needle points to zero, and passing the key, a deflection of between 80° and 85° should be shown. This is called "testing the battery on short circuit."

A magnet is supplied for the purpose of steadying the needle when there is motion, or reducing the deflection when it is too great; when not required for use it is kept in a pocket in the strap of the leather containing case.

After the test battery has been in action six months, the sawdust is to be changed and the copper cup recharged with sulphate of copper. Any copper sulphate crystals found can be used over again. At the same time the connections of the insulated wires with the zinc and the copper cup should be carefully examined, and the incrustation cleaned from the zinc so as to leave a clean surface on the under side at any rate.

Should the battery show indications of loss of power, and these measures fail to restore it, a new battery must be rendered active.

BATTERY AND KEY, TEST AND FIRING.*

This key and battery is designed to serve two purposes:—

1. To test the tube and circuit when the gun is made ready to fire.
2. To fire the tube.

To enable this to be done an indicator is fitted within the firing key itself, which is so arranged that when the knob is turned to the right the current passes through the indicator and the rest of the gun circuit, and if this is complete a visible and audible signal is given. If it is then required to fire, the knob is pressed in, which action cuts the indicator out and allows the full current to flow through the circuit firing the tube.

An arrow is cut on the face of the knob as an indicator; when the arrow is vertical the circuit is broken and the gun cannot be fired.

Besides this, the apparatus may be used in place of the Menotti cell and galvanometer for testing tubes and firing wires.

The Leclanché cells, of which there are two in the battery box, are issued with the sal ammoniac in them, and all that is required to make them ready for use is to fill the cells two-thirds full with water, and to see that this is added from time to time to make up for evaporation.

When the battery fails to fire a tube, fresh sal ammoniac (about 4 oz. to each cell) should be added; the old solution being thrown away.

The apparatus is suitable for firing any low tension fuze or tube through a short length of wire, about 50 yards of No. 16 copper wire (.065 inch diameter).

* When "Battery and Key, Test and Firing," is issued, the Leclanché and Menotti Batteries are not required.

PRECAUTIONS TO BE OBSERVED.

Before any wires are attached to the key, care should be taken that the arrow on the knob points upwards, and the key should be tried to see that it works freely and correctly.

The firing wires must not both be connected up to the firing key until after the gun is laid and ready to fire, and the front is clear. The turning of the knob should be done just before it is required to fire, and it may either be held turned or not as desired until the gun is fired by pressing it in.

The following rules will detect the particular cause of failures to fire with electric tubes:—

1. If the indicator works properly, and yet when the knob is pressed in the tube does not fire, the fault is a short circuit between the firing leads or in the tube itself.
2. If the indicator works feebly only, some bad joint in the circuit will be the probable cause.
3. If it does not move at all, the circuit is broken at some point in the wires or in the tube itself.
4. If the indicator works when the knob is turned and the gun does not fire when it is pressed, and then when the knob is turned again the indicator does not work, this shows that the tube has fired without igniting the charge.

To eliminate faulty tubes it is as well to test them before use out of the gun. This should be done under precaution, so that in case of a tube being accidentally fired no damage would ensue. The firing leads may also be tested, and the apparatus may be considered to be in good order, if on joining the terminals with a short bit of wire, and turning the knob, the indicator works well. If it should only work feebly the battery should be examined, as in this case it will not give sufficient current to fire with certainty.

RANGE TABLE FOR 10-INCH D.L. GUN (FULL CHARGE).

Based on Practice of 3 and 4.3.90 and 30.4.90.

Minutes 20,607, 23,361.

Charge { weight, 252 lb.
 gravimetric density, $\frac{33.23}{0.844}$.
 nature of powder, Prism¹ brown.

Projectile—weight, 500 lb.
 Muzzle velocity—2040 f.s.
 Jump—not allowed for.

Range.	Elevation.	Slope of descent.	Remaining velocity.	5 minutes' elevation increases or decreases the range by	5 minutes will alter point of impact vertically or laterally at each range.	Time of flight.
yards	" "	1 in	f.s.	yards	yards	seconds
100	0 4	666	2022	129	—	0.14
200	0 8	382	2005	127	0.29	0.28
300	0 12	257	1990	125	0.43	0.43
400	0 16	200	1975	124	0.58	0.58
500	0 20	156	1957	122	0.72	0.84
600	0 25	132	1940	121	0.87	0.89
700	0 29	114	1925	119	1.01	1.04
800	0 33	101	1910	118	1.16	1.20
900	0 37	90	1895	116	1.31	1.36
1000	0 41	80	1878	115	1.45	1.54
1100	0 45	72	1863	113	1.60	1.68
1200	0 50	64	1850	112	1.74	1.85
1300	0 54	58	1833	111	1.89	2.02
1400	0 59	53	1816	110	2.03	2.19
1500	1 3	49	1800	109	2.18	2.36
1600	1 8	46	1784	108	2.32	2.52
1700	1 12	43	1770	106	2.47	2.70
1800	1 17	41	1753	104	2.61	2.86
1900	1 22	39	1740	102	2.76	3.03
2000	1 27	37	1728	100	2.91	3.20
2100	1 31	35	1714	98	3.05	3.37
2200	1 36	33	1700	96	3.21	3.54
2300	1 40	31	1685	95	3.34	3.72
2400	1 45	29	1670	93	3.49	3.91
2500	1 49	27	1656	92	3.63	4.07
2600	1 54	26	1642	91	3.78	4.24
2700	1 59	25	1628	90	3.92	4.43
2800	2 4	24	1614	89	4.07	4.60
2900	2 9	23	1600	87	4.21	4.79
3000	2 15	22	1587	86	4.36	5.00
3100	2 20	21	1574	84	4.51	5.18
3200	2 26	20	1562	83	4.65	5.36
3300	2 31	19	1547	82	4.80	5.56
3400	2 37	18	1536	81	4.94	5.76
3500	2 42	17	1522	80	5.09	5.96
3600	2 48	16	1508	79	5.23	6.16
3700	2 54	15	1495	78	5.38	6.36
3800	3 0	14	1482	77	5.52	6.56
3900	3 6	14	1469	76	5.67	6.77
4000	3 12	13	1456	74	5.81	6.98
4100	3 18	13	1443	73	5.96	7.20
4200	3 24	12	1430	72	6.11	7.43
4300	3 30	12	1417	70	6.25	7.66
4400	3 36	11	1404	69	6.40	7.90
4500	3 42	11	1391	68	6.54	8.14

RANGE TABLE—continued.

Range.	Elevation.	Slope of descent.	Remaining velocity.	5 minutes' elevation increases or decreases the range by	5 minutes will alter point of impact vertically or laterally at each range.	Time of flight.
yards	"	"	f.s.	yards	yards	seconds
4600	3 49	1 in 11	1378	67	6 60	8 38
4700	3 56	" 10	1365	66	6 53	8 42
4800	4 3	" 10	1352	65	6 58	8 56
4900	4 10	" 10	1343	64	7 13	9 10
5000	4 18	" 9	1323	63	7 27	9 34
5100	4 25	" 9	1311	62	7 42	9 58
5200	4 33	" 9	1300	61	7 56	9 83
5300	4 40	" 9	1289	60	7 71	10 08
5400	4 48	" 8	1277	59	7 85	10 33
5500	4 55	" 8	1265	58	8 00	10 56
5600	5 3	" 8	1253	57	8 14	10 82
5700	5 11	" 8	1241	56	8 29	11 06
5800	5 19	" 8	1230	55	8 43	11 30
5900	5 27	" 8	1220	54	8 58	11 53
6000	5 35	" 7	1210	53	8 73	11 77
6100	5 43	" 7	1199	52	8 87	12 01
6200	5 51	" 7	1189	51	9 01	12 25
6300	5 59	" 7	1180	50	9 16	12 40
6400	6 8	" 7	1170	49	9 30	12 65
6500	6 16	" 6	1161	48	9 45	13 00
6600	6 25	" 6	1152	47	9 60	13 24
6700	6 33	" 6	1143	46	9 74	13 48
6800	6 42	" 6	1136	45	9 89	13 72
6900	6 51	" 6	1128	44	10 03	13 97
7000	7 0	" 5	1121	43	10 18	14 22
7100	7 8	" 5	1112	42	10 32	14 47
7200	7 17	" 5	1104	41	10 46	14 72
7300	7 25	" 5	1097	40	10 60	14 97
7400	7 34	" 5	1090	39	10 75	15 22
7500	7 43	" 4	1083	38	10 89	15 48
7600	7 52	" 4	1076	37	11 04	15 74
7700	8 0	" 4	1070	36	11 19	16 00
7800	8 9	" 4	1064	35	11 34	16 28
7900	8 18	" 4	1060	34	11 48	16 46
8000	8 27	" 4	1056	33	11 63	16 83
8100	8 36	" 4	1053	32	11 77	17 10
8200	8 46	" 4	1048	31	11 92	17 40
8300	8 55	" 4	1043	30	12 07	17 67
8400	9 4	" 4	1036	30	12 22	17 96
8500	9 13	" 4	1031	29	12 36	18 24
8600	9 23	" 4	1026	28	12 50	18 52
8700	9 32	" 4	1022	27	12 65	18 82
8800	9 42	" 4	1017	26	12 80	19 10
8900	9 51	" 4	1012	26	12 94	19 40
9000	10 1	" 4	1008	25	13 08	19 70
9100	10 11	" 4	1004	25	13 23	20 00
9200	10 21	" 3	999	25	13 37	20 30
9300	10 31	" 3	995	25	13 52	20 62
9400	10 41	" 3	989	25	13 66	20 93
9500	10 51	" 3	985	24	13 81	21 25
9600	11 1	" 3	981	24	13 96	21 56
9700	11 11	" 3	976	24	14 11	21 87
9800	11 21	" 3	974	24	14 26	22 19
9900	11 31	" 3	971	24	14 40	22 52
10000	11 41	" 3	967	24	14 55	22 84

DRILL.

FOR 10-INCH B.L. GUN ON BARBETTE MOUNTINGS,
MARKS II AND III.*

N.B.—The drill as here laid down is for the Mark II mounting; the only difference entailed by the Mark III mounting is the omission of "elevates" in number 5's duties, as the elevating gear is on the right side only.

Gun Detachments.

A gun detachment consists of a Gun Captain (No. 1),† a Gun Layer, and eleven other gun numbers.

It falls in two deep, the Gun Captain being on the left of the front rank, and the Gun Layer covering him.

To tell off.‡

<i>Group Officer.</i>	|	<i>Gun Captain.</i>
"Group, Tell Off."		"Tell Off."

At "Tell Off," the Gun Captain takes a pace to the front, turns to his right, and gives the word "Tell Off."

The Gun Layer does not number.

The right hand man of the rear rank numbers 2; the right hand man of the front rank 3; the second man from the right of the rear rank 4; his front rank man 5, and so on.

After the detachment is told off, the Gun Captain falls in again on the left of the front rank.

The detachment is then marched into the work and halted in line facing the mounting, and in rear of it, or to such other convenient position under cover as the Group Officer may direct.

If more than one gun of a group is being manned, each Gun Captain marches his detachment to his gun as above.

General Duties.

The Gun Captain§ (No. 1) commands, and is responsible to the Group Officer for the regular and efficient service of the gun in all respects.

* N.B.—When drilling without a Group Officer, the directions, cautions, and commands laid down in this to be given by the Group Officer will be given by the Gun Captain.

† In exceptional cases the Gun Captain may also have to perform the duties of Group Officer.

‡ This should be done, as far as possible, on private parades, before marching off from parade, camp, or quarters.

§ It is recommended that, when possible, this Non-commissioned Officer should have permanent charge of the gun, and be responsible for its condition and cleanliness, and all the stores, &c., connected with it, and also for the casemate or emplacement in which it is mounted.

When at practice he is responsible to the Group Officer that his gun is laid on the target ordered.

When his gun is fought by position finder (P. F.), he will insert the firing plug after the gun is laid.

Reads and gives Quadrant Elevation (Q.E.) to elevating numbers, when the latter cannot read the means themselves.

When time fuzes are employed he sets fuzes.

The "Gun Layer."—His especial duty is the laying of the gun.

When direction is given by the training arc, reads the training and directs (by signal or otherwise) the traversing numbers.

He attends to the vent, locks, and makes ready.

"No. 2."—Attends to cam lever, withdraws, and cleans the breech-block, assists 3 with loading trays, steadies and guides projectile, unhooks lower block of hoisting tackle, removes selvagee or sling, rams home, inserts breech-block, traverses, and sponges if necessary.

"No. 3."—Attends to ratchet lever, unlocks and assists to withdraw breech-block,* places loading trays, steadies and guides projectile on to loading tray, uncaps fuze, or removes safety pins, loads, removes shalloon patch from end of last cartridge, rams home, removes loading trays, assists to insert breech-block, traverses, removes residue from chamber, and mushroom head with scraper and brush after every round, and assists 2 to sponge if necessary.

"No. 4."—Supplies loading trays and side arms, rams home, supplies 2 with cartridges, elevates, and fires.

"No. 5."—Attends to the loading derrick, steadies and guides the projectile in raising, rams home, supplies 3 with cartridges, and elevates.

"Nos. 6, 9, 11, and 12."—Attend to the cartridge lift or outside the cartridge expense store, 6 and 12 supply 4, 9 and 11 supply 5 with cartridges, removing empty cylinders; No. 9 also traverses.

"No. 7."—Attends to the shell lift or outside the shell expense store, fixes fuzes, brings up and raises projectile, and removes empty barrow.

"No. 8."—Assists 7 at shell lift or outside the shell expense store, brings up projectile, hooks lower block of hoisting tackle, and raises projectile.

"No. 10."—Assists 4 to supply loading trays and side arms to 2 and 3, traverses, and attends to pump of floating pivot.

To prepare for action and examine gun.

Group Officer.

Gun Captain.

"Prepare for action and examine Gun."

"Prepare for action
Examine Gun."

At "Prepare for action," each number brings up his stores† as under.

"Gun Layer."—Sights, tubes, lanyard,‡ tube extractor, rimer, and percussion or electric lock. For drill purposes a drill tube.

"No. 2."—Side arms (consisting of sponge, rammer, and scraper with brush) and loading trays.

* If the gun is fitted with control gear, 3 withdraws and inserts the breech block by its means, and 2 and 3's duties will be altered accordingly.

† Some of these stores will be already on the guns.

‡ If an A lock is used with the gun, two lanyards (cocking and firing) and spare strikers will be required.

"No. 3."—Traversing handles, key for muzzle tampeon (if used), oil can, Russian tallow, and waste.

"No. 4."—Elevating wheel, and assists 2 with side arms and loading trays.

"No. 5."—Elevating wheel, two rammer ropes when required, and winch handle.

"No. 6."—Assisted by 9, 11, and 12, bucket filled and brush, and for drill purposes four zinc cylinders and four drill cartridges.

"Nos. 7 and 8."—Transporting barrow and brush, two selvages or slings, fuzes, fuze and shell implements, and piece of chalk. For drill purposes a drill shell.

"No. 10."—Assists 2 and 4 with side arms and loading trays, and handle of floating pivot pump.

The stores having been brought up and found correct, the Gun Captain will give "Examine Gun," and see—

That the gun itself is properly examined by the numbers whose duty it is to do so.

That the buffers are filled with the proper amount of oil, and the scales set to give the correct recoil.

That the racers are clean.

He will receive the fuze key from 7.

He receives reports from the numbers responsible, of any irregularity or deficiency in connection with the different parts of the gun, carriage, slide, and stores.

As soon as the breech has been opened by 2 and 3, he looks through the bore, and sees that it is clear.

When firing by P.F. he sees that the firing plug is ready for use, and the electric lanyard attached to the proper binding screws.

When firing by electricity he will be responsible that the firing battery and wires are correct and ready for use. (See page 98.)

The "Gun Layer" receives the tubes from the shell store.

He coils up the lanyard, placing it, with the extractor, rimer and tubes in a recess or other convenient position in the emplacement or mounting, and having examined the lock, places it in position on the breech-block.

He then fires a tube,* sees that the lock is in good working order, and rimes out the vent.

When the P.F. is used, he coils up the electric lanyard and places it in the firing plug box, clear of the detachment.

He fixes the sights, taking care that the fore sights fit properly, and that the deflection leaves of the hind sights work easily, and sees that the pointer for training arc is let down to position for reading training.

"No. 2."—Arranges the side arms and loading trays,† and sees that the traversing gear is oiled and in working order.

"No. 3."—Places on the traversing handles, and removes the muzzle tampeon and breech apron.

"No. 4."—Assists 2 to arrange the side arms and loading trays, puts on elevating wheel on his own side, and sees that the elevating gear is oiled and in good working order.

* N.B.—Before firing the tube the Gun Captain will see that no one is in front of the muzzle, particularly with Mark IV electric or Mark III percussion tubes. See notes on tubes on page 64.

† The loading tray or trays, if found convenient, may be placed across the top of the counterweight; they are quite secure and stable in this position when the gun is fired.

"No. 5."—Puts on winch handle and elevating wheel on his own side, places the rammer ropes (when used) with the side arms, and rigs the hoisting tackle.

If necessary 4 and 5 elevate the gun till it is in a convenient position for loading, and clamp the gear.

"No. 6."—Places the bucket of water and brush near the head of the sidearms, and assisted by 9, 11, and 12, loosens or removes bands from covers of cylinders as required, if not already done. At drill, 6, 9, 11, and 12 place the zinc cylinders with drill cartridges at the head of cartridge lift or outside cartridge expense store.

"Nos. 7 and 8."—Place the stores they have brought up in a convenient position ready for use. At drill, the drill shell is to be placed at the head of shell lift or outside shell expense store.

"No. 10."—Assists 2 and 4 with sidearms and loading trays, and ships handle of floating pivot pump.

The breech will then be opened as follows, 2 and 3 mounting on to the loading stage:—

2 raises the cam lever into its upright position, 3 raises the ratchet lever to its full extent, sees that the ratchet catches, and with both hands forces it down till the cam lever is against the stop, 2 then starts the movement of the breech block by lowering the cam levers, raising it into its upright position again; 2 and 3 then withdraw the breech-block, and when clear swing it round on its carrier ring until it is caught by the spring latch.

2 then examines the breech-block and sees that it is clean and the threads free from burrs, lubricating them with a slight film of oil, and rubbing the asbestos pad with Russian tallow or grease, 3 examines the bore, chamber and threads of breech, also lubricating the threads with a slight film of oil.

"To close the breech" 2 releases the spring latch, and, assisted by 3, swings round the breech-block, and pushes it home, 3 works the ratchet lever until the cam lever can be folded down* by 2, 3 then releases the ratchet lever and allows it to fall into its place.

If the gun is fitted with control gear, 3 withdraws and inserts the breech-block by its means; in this case the cam lever will not be folded down when opening the breech.

After each number has completed his work as above, he takes up his position under cover as follows; † the numbers should then, if possible, be sitting or lying down. §

"Gun Captain."—Where he can best regain his position for superintending the working of the gun.

"Gun Layer."—In rear of the slide when possible.

"Nos. 2, 4, and 10."—On the right of gun.

"Nos. 3 and 5."—On the left of the gun.

2 and 3 being next the muzzle, and 4, 5, and 10 outside them.

"Nos. 6, 9, 11, and 12."—At the head of the cartridge lift or outside cartridge expense store.

"Nos. 7 and 8."—At the head of shell lift, or outside shell expense store.

* If the gun is fitted with a D percussion lock, as the raising of the cam lever cocks the lock, the lever should not be folded down when the breech is closed, 2 seeing that the breech block is turned into its proper position.

† But they may be locally arranged for otherwise, so long as the men know exactly where to go, and are near enough to spring from thence rapidly to their work.

§ The detachment when at drill may be either standing or sitting down, at the option of the instructor.

To Load.

<i>Group Officer.</i>	<i>Gun Captain</i>
"..... <i>Group.</i> "	"..... <i>Gun.</i> "
*"..... <i>Load.</i> "	"..... <i>Load.</i> "

The "Gun Layer" mounts on to the landing stage, and adjusts his tangent sight approximately to the range shown on the indicator dial or other means of passing ranges, or as ordered by the Group Officer, as the case may be, and to the deflection given by the Group Officer, keeping clear of the working of the gun.

When P.F. is used he does not touch the tangent sights, but connects the electric lanyard to a tube.

"Nos. 2, 3, 4, and 5."—Mount on to the landing stage, 2 and 3 open the breech (if it has been closed after examining the gun) as before detailed. 2 and 3 receive the loading tray from 4 (and 10 if it is not kept on counterweight) and place it in the chamber.

"Nos. 7 and 8."—Bring up the projectile on its barrow, 5 attends to the derrick, 8 hooks the derrick tackle to the selvagee or sling; 7 and 8, manning the winch handle, raise the projectile, 5 steadying it, and when high enough swinging it in towards the breech of the gun; 2 and 3 then steady and guide the projectile, and when over the loading tray, 3 holds up his hand as a signal to ease off by means of the brake. As soon as the projectile is lowered on to the tray, 2 casts loose the selvagee or sling, 3 uncaps the fuze or removes the safety pins, 5 swings the derrick clear, 4 receives the rammer from 10, and supplies it to 2 and 3; the rammer is manned by 2 and 4 on the right, 3, and 5 on the left side; the projectile is then rammed home,† when home, 2 and 3 raise their arms, spring the rammer, and lay it on the loading stage.

2 and 3 then withdraw the shot loading tray, and hand it to 10. 4 supplying the cartridge tray, which is placed in the bore by 2 and 3 (if separate loading trays are used).

"Nos. 6 and 12, 9 and 11."—Bring up the cartridges in zinc cylinders, with lids unscrewed, on each side of the slide, 6 and 12 on the right, 9 and 11 on the left side, and having removed the lids, hold the cylinders up to 4 and 5, who withdraw them from the cylinders, hand them to 2 and 3, who place them in the chamber separately, pushing them home by hand or using the rammer if necessary, 3 removes the shallow patch from end of last cartridge, withdraws the cartridge tray, and hands it to 4, who, with 10, replaces it and the rammer; the breech is then closed as before detailed. 2, 3, 4, and 5 then dismount from the loading stage.

Making Ready, Elevating, and Traversing.

As soon as the breech has been closed, the Gun Layer puts a tube in the vent,‡ hooks the lanyard§ and throws it over the end of slide,

* "Palliser," "Common," "Case," or "Shrapnel," as the case may be, the Group Officer giving the nature and length of fuze if required.

† Should the projectile be "not home," 2 and 3 raise their arms and wave their hands twice across; the projectile is then forced home.

‡ The tube is never to be inserted before the breech is properly closed under any pretext whatever.

§ If the gun is fitted with an A lock, the Gun Layer will hook both the cocking and firing lanyards.

being careful to note that the guide bolt of the lock is home in the cam groove. He then proceeds to lay his gun.

When P.F. is used he puts in the electric tube and takes care that the lanyard is clear of the slide, so as not to be cut by the gun carriage on recoil.

2, 3, 9, and 10 man the traversing handles, 10 first raising the slide into the traversing or raised position by working the handle of the floating pivot pump, 4 and 5 man the elevating wheels.

The remaining numbers go under cover.

The Gun Layer gives directions to the elevating numbers in a low tone when tangent scales are used, but when Q.E. is used and the elevating numbers cannot read it, the Gun Captain directs them.

The Gun Layer directs the traversing numbers by word of command, or signals, if signals can be seen. (For signals see page 84.)

N.B.—When firing at a moving object, and using tangent sights for direction, the gun and slide must be kept in the raised position on the pivot, in order that the traversing may be easily and quickly performed, and the sights kept on the target.

When P.F. is used, or when firing at a standing or moored target, the gun and slide will be lowered on to the pivot before firing.

The lowering of the gun and slide increases the elevation about five minutes; this must of course be allowed for if the gun is laid either by tangent scale or Q.E. before being lowered.

LAYING AND FIRING.

Case I.

I.—When elevation and direction are given by tangent scale.

Gun Layer lays his gun with the deflection ordered and the elevation as shown on indicator dials or other means provided for passing ranges or as ordered by the Group Officer, altering it now and then as the dial or other means alter, or as ordered by Group Officer, as the case may be, until the final range is given as follows:—

Final Range.

<i>Group Officer.</i>	<i>Gun Captain.</i>
"..... Group."	"No. Gun."
or	
"..... Gun."	"..... Yards Lay."
"..... Yards Lay."	

At the order "*Lay*," the Gun Layers, or only that of the gun named, as the case may be, adjust the tangent sight to the exact elevation ordered.

NOTE.—If the gun or guns of a group are to be fired as soon as possible after being loaded, the Group Officer should give the final range immediately the loading is completed. When firing at a stationary target, the Gun Layer as soon as he has received the final range and laid his gun, descends from the slide and goes under cover, the elevating and traversing numbers doing the same, until the Group Officer gives the order "..... Group" or "No. Gun. Commence Firing."

Commence Firing.

<u>Group Officer.</u>	<u>Gun Captain.</u>
" Group."	(on seeing that the Gun Layer has descended off slide)
or " Gun."	" Gun,
" Commence Firing."	" Fire."

At the order "*Commence Firing*" the Gun Layers of the Group, or of the gun named, will make any final correction of the laying that may be necessary, fold down the cam lever, or with an A lock cock the lock, and descend from the loading stage.

As soon as the Gun Layer has descended from the slide, 4 and 5 clamp the elevating gear, and 5 goes under cover, 4 seizes the lanyard, and on the order "*Fire*" from the Gun Captain, fires; 2, 3, 9, and 10 remain on the traversing handles until the gun is fired.

NOTE.—In case of a missfire (i.e., the tube not being fired), the Gun Layer, after a pause of half a minute, will mount on to the loading stage and recock the lock by raising and lowering the cam lever (with an A lock 4 re-cocks with cocking lanyard.) On another missfire the tube should be extracted and the lock examined by the Gun Layer.

In the event of a tube firing, but failing to ignite a charge, after a pause of a minute the tube must be extracted by the Gun Layer, and another one inserted.

Under no circumstances should the breech be opened with a tube in the vent.

Case II.

II.—When using sighting steps, straight edged sights,* and quadrant elevation.

The Gun Layer having folded down the cam lever,† stands on the sighting step and keeps his gun trained on the target, laying only for direction.

4 and 5 elevate or depress to the elevation ordered by the Gun Captain reading the quadrant elevation, unless means are provided which they can read themselves, when they will take it from such means.

The "elevation ordered" will be that shown on the indicator dial, or other means of exhibiting ranges, or as ordered by the Group Officer as the case may be. (For electric firing see page 98.)

Final Range.

<u>Group Officer.</u>	<u>Gun Captain.</u>
" Group."	" Gun."
or	" yards Lay."
" Gun."	
" yards Lay."	

* During the loading the gun layer will have set the tangent scale at the approximate range; it may, however, be necessary for him to further alter it in order that the target may be in the field of the straight-edge.

† Or with an A percussion lock, cocked the lock.

At the order "*Lay*," the elevating numbers carefully give the final elevation ordered, directed if necessary by the Gun Captain.
4 seizes the lanyard and stretches it taut.

Commence Firing.

<p><i>Group Officer.</i></p> <p>"..... <i>Group.</i>"</p> <p style="text-align: center;">or</p> <p>"..... <i>Gun.</i>"</p> <p>"Commence <i>Firing.</i>"</p>	<p><i>Gun Captain.</i></p> <p>(on getting signal from Gun Layer.)</p> <p>"..... <i>Gun, Fire.</i>"</p>
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At the order "*Commence Firing*," the Gun Layer will rapidly make any final correction of the laying, and hold up his right hand over his head when on the target, afterwards 4 fires the gun (by pressing firing key or pulling lanyard) on the order "*Fire*" from the Gun Captain.

2, 3, 9 and 10 remain on the traversing handles until the gun is fired.

Case III.

III. With quadrant elevation and training arc.

4 and 5 elevate or depress as in Case II, except that when P.F. is used they give the elevation as called by the dial number, directed if necessary by the Gun Captain.

The Gun Layer reads the training by pointer as given by Group Officer or otherwise (or with P.F. by the dial number), and directs the traversing numbers as required.

Final Range.

At the order from the Group Officer or "dial number," "*Range... yards. Training... degrees, Lay*," 4 and 5 give the exact elevation called out (directed if necessary by the Gun Captain) and go under cover; unless when firing is not with P.F., when 4 seizes the lanyard or connects up wire to firing battery. The Gun Layer, with the help of 2, 3, 9 and 10, gives the exact training, and goes under cover; 2, 3, 9 and 10 remaining on the handles.

Commence Firing.

The Gun Captain satisfies himself that the gun is laid on the proper target.

If P. F. is not used, the words of command will be as in Case II, and 4 will fire on the Gun Captain giving the word.

Firing with P.F.

But when firing by P.F., the Gun Captain puts in the firing plug and runs to the rear of the slide, where he can best be seen by the Group Officer, holding up his hand in line with his shoulder; he must,

however, inform the Group Officer if he cannot be seen by him, by word of mouth, signal, or as may be most convenient.*

When the Group Officer gives to the dial number the word or signal "*Commence Firing*," he goes under cover.

Scraping and Sponging Out.

As soon as the gun is fired, the Gun Captain removes the firing plug, if P.F. is used 2 and 3 open the breech, the Gun Layer unhooks the lanyard, extracts the old tube and rimes out the vent (with P.F. coils up the lanyard and puts it in the firing plug box). When using brown powder, 4 supplies the scraper with brush to 3, and if necessary the sponge (wetted) to 2.

3 scrapes and brushes out the residue left from the previous round, being careful that the threads in the breech are not choked with it.

If necessary 2, assisted by 3, sponges out, taking the same precautions; 4 replaces the scraper and sponge.

To Unload at Drill.

The gun is unloaded by the same numbers as loaded it, 4 and 10 supplying the necessary trays.

As soon as the gun is unloaded, 4 supplies 3 with scraper, and 3 scrapes and brushes out chamber as before detailed.

To Cease Firing and Replace Stores.

<u>Group Officer.</u>	<u>Gun Captain.</u>
".... Group."	".... Gun."
" <i>Cease Firing and Replace Stores.</i> "	" <i>Cease Firing and Replace Stores.</i> "

The Gun Captain sees that Nos. 4 and 5 depress till the gun is at an angle of about 4°. The stores are replaced by the numbers who brought them up. After replacing stores the detachment falls in two deep in rear of slide, as at first.

To Run Back.

If necessary guns on these mountings can be run back as follows:—

A special derrick is attached to the bracket of the carriage on the right side, and by a hoisting tackle attached to it the pump is hoisted high enough to allow a projection on the bottom of it to rest in a recess in the bracket of carriage. It is now clamped in this position by two clamps attached to bracket. The connecting pipe is attached to delivery on pump and the filling hole in rear of the right buffer. By attaching and working pump handle,† the gun can be run back the required amount.‡

* NOTE.—The pump is also used in this manner for filling the

* Should a fresh prediction be necessary or the signal or order "*Stand fast*" be given before the Group Officer orders "*Commence firing*," the Gun Captain will immediately remove the firing plug, and the service of the gun will continue as before.

† Nos. 4 and 10 bring up and attach pump handle, which is manned by 4, 7, 8, and 10.

‡ When running back the bye-pass valve of the pump must be kept closed, and opened to run up again, the Gun Layer attending to the valve.

buffers, or they may also be filled in the ordinary manner, but owing to the small aperture at the filling hole, it takes a considerable time.

To Take Post Under Cover and Form Detachment Rear.

The movements are required at times. They will be as follows :—

To Take Post Under Cover.

<u>Group Officer.</u>	|	<u>Gun Captain.</u>
<i>"Take Post under Cover."</i>		<i>"Double March."</i>

Each man doubles at once to his position, as given on page 73.

To Form Detachment Rear.

<u>Group Officer.</u>	|	<u>Gun Captain.</u>
<i>"Detachment Rear."</i>		<i>"Double March."</i>

The Gun Captain doubles out and places himself on the left rear of the mounting, facing to the front. On the word "*Double March*," the numbers double to their places in "*Detachment Rear*," halting and fronting as they come up.

DRILL FOR 10-INCH B.L. GUN ON BARBETTE MOUNTING. (MARK I.)*

Gun Detachment.

The gun detachment consists of a Gun Captain (No. 1), a Gun Layer, and eleven other gun numbers.

The detail for falling in and telling off a detachment is the same as in drill for Mark II Mounting.

General Duties.

The Gun Captain† (No. 1) commands, and is responsible to the Group Officer for the regular and efficient service of the gun in all respects.

* N.B.—When drilling by single gun without a Group Officer, the directions, cautions, and commands laid down in this to be given by Group Officer, will be given by the Gun Captain. Also see note *, page 70.

† It is recommended that, when possible, this Non-commissioned Officer should have permanent charge of the gun, and be responsible for its condition and cleanliness, and all the stores, &c., connected with it, and also for the casemate or emplacement in which it is mounted.

When at practice he is responsible to the Group Officer that his gun is laid on the target ordered.

When his gun is fought by position finder (P.F.), he will insert the firing plug after the gun is laid.

Reads and gives Q.E. to elevating numbers, when the latter cannot read the means themselves.

When time fuzes are employed he sets them.

The "Gun Layer."—His especial duty is the laying of the gun.

When direction is given by the training arc, reads the training and directs (by signal or otherwise) the traversing numbers.

He attends to the vent, locks, and makes ready.

"No. 2."—Attends to cam lever, withdraws, and cleans the breech-block, assists 3 with loading trays, steadies and guides projectile, unhooks lower block of hoisting tackle, removes solvage or sling, rams home, inserts breech-block, traverses, and sponges if necessary.

"No. 3."—Attends to ratchet lever, unlocks and assists 2 to withdraw breech-block,* places loading trays, steadies and guides projectile on to loading tray, uncaps fuze, or removes safety pins, loads, removes shalloon patch from end of last cartridge, rams home, removes loading trays, assists to insert breech block, traverses, removes residue from chamber and mushroom head with scraper and brush after every round, and assists 2 to sponge if necessary.

"No. 4."—Supplies loading trays and side arms, rams home, elevates, and fires.

"No. 5."—Attends to the loading derrick, steadies and guides the projectile in raising, and rams home, and assists to traverse if required.

"Nos. 6, 9, 11, 12."—Attend to the cartridge lift or outside cartridge expense store, and supply 2 and 3 with cartridges, removing empty cylinders; No. 9 also traverses.

"No. 7."—Attends to the shell lift or outside the shell expense store, fixes fuzes, brings up and raises projectile, rams home, and removes empty barrow.

"No. 8."—Assists 7 at shell lift or outside the shell expense store, brings up projectile, hooks lower block of hoisting tackle, raises projectile, and rams home, and assists to traverse if required.

"No. 10."—Assists 4 to supply loading trays and side arms to 2 and 3, traverses, and releases the running up lever (if the gun is loaded in the run back position).

To Prepare for Action and Examine Gun.

Group Officer.

"Prepare for action and examine Gun."

Gun Captain.

"Prepare for action. Examine Gun."

At "Prepare for action" each number brings up his stores as under.†

"Gun Layer."—Sights, tubes, lanyard,‡ tube extractor, rimer and percussion or electric lock. For drill purposes a drill tube.

* If the gun is fitted with control gear, 3 withdraws and inserts breech-block by its means, and 2 and 3's duties will be altered accordingly.

† Some of these stores may be already on the guns.

‡ If an A lock is used with the gun, two lanyards (cocking and firing) and spare strikers will be required.

"No. 2."—Side arms (consisting of sponge, rammer, and scraper and brush) and loading trays.

"No. 3."—Traversing handles, key for muzzle tampeon (if used), oil can, Russian tallow, and waste.

"No. 4."—Elevating wheel, and assists 2 with side arms and loading trays.

"No. 5."—Two rammer ropes when required, hoisting tackle, and winch handle.

"No. 6."—Assisted by 9, 11, and 12, bucket filled and brush, and for drill purposes four zinc cylinders and four drill cartridges.

"Nos. 7 and 8."—Transporting barrow and brush, two selvagees or slings, fuzes, fuze and shell implements, and piece of chalk. For drill purposes a drill shell.

"No. 10."—Assists 2 and 4 with side arms and loading trays.

The stores having been brought up and found correct, the Gun Captain will give "*Examine Gun*" and see—

That the gun itself is properly examined by the numbers whose duty it is to do so.

That the buffers are filled with the proper amount of oil, and the scales set to give the correct recoil.

That the racers are clean.

He will receive the fuze key from 7.

He receives reports from the numbers responsible of any irregularity or deficiency in connection with the different parts of the gun, carriage, slide, and stores.

As soon as the breech has been opened by 2 and 3, he looks through the bore and sees that it is clear.

When firing by P.F. he sees that the firing plug is ready for use, and the electric lanyard attached to the proper binding screws.

When firing by electricity he will be responsible that the firing battery and wires are correct and ready for use.

"The Gun Layer" receives the tubes from the shell store.

He coils up the lanyard, placing it with the extractor, rimer, and tubes in a recess or other convenient position in the emplacement or mounting, and having examined the lock, places it in position on the breech-block.

He then fires a tube,* sees that lock is in good working order, and rimes out the vent.

When the P.F. is used he coils up the electric lanyard and places it in the firing plug box, clear of the detachment.

He fixes the sights, taking care that the fore-sights fit properly, and that the deflection leaves of the hind-sights work easily, and sees that the pointer for training arc is let down to position for reading training.

"No. 2."—Arranges side arms and loading trays, and sees that the traversing gear is oiled and in working order.

"No. 3."—Puts on traversing handles, and removes the muzzle tampeon and breech apron.

"No. 4."—Assists 2 to raise the side arms and loading trays, puts on elevating wheel on his own side, and sees that the elevating gear is oiled and in good working order.

"No. 5."—Puts on winch handle, places the rammer ropes (when used) with the side arms, and rigs the hoisting tackle.

If necessary, 4 elevates the gun till it is in a convenient position for loading, and clamps the gear.

* N.B.—Before firing the tube the Gun Captain will see that no one is in front of the muzzle.

"No. 6."—Places the bucket of water and brush near the head of the side arms, and, assisted by 9, 11, and 12, loosens or removes bands from covers of cylinders as required, if not already done. At drill, 6, 9, 11, and 12 place the zinc cylinders with drill cartridges at the head of cartridge lift or outside cartridge expense store.

"Nos. 7 and 8."—Place the stores they have brought up in a convenient position ready for use. At drill, the drill shell is to be placed at the head of shell lift or outside shell expense store.

"No. 10."—Assists 2 and 4 with sidearms and loading trays, and sees that the running up gear is in good order.

The breech will then be opened as follows, 2 and 3 mounting on to the slide:—

To Open and Close the Breech.

No. 4 elevates the gun into the loading position (to facilitate the withdrawal of the breech-block, if gun is in run back position).

2 raises the cam lever into its upright position, 3 raises the ratchet lever to its full extent (sees that the ratchet catches), and with both hands forces it down till the cam lever is against stop, 2 then starts the movement of the breech block by lowering the cam lever, raising it into the upright position again, 2 and 3 then withdraw the breech-block, and when clear swing it round on its carrier ring until it is caught by the spring latch.

2 then examines the breech-block and sees that it is clean and the threads free from burrs, lubricating them with a slight film of oil, and rubbing the asbestos pad with Russian fallow or grease; 3 examines the bore, chamber, and threads of breech, also lubricating the threads with a slight film of oil.

"To close the breech." If gun is in run back position, No. 4 depresses the gun (to render the insertion of the breech-block easy) on a signal from 2, 2 releases the spring latch, and, assisted by 3, swings round the breech-block, and pushes it home, 3 works the ratchet lever until the cam lever can be folded down* by 2, 3 then releases the ratchet lever and allows it to fall into its place. If the gun is fitted with control gear, 3 withdraws and inserts the breech-block by its means; in this case the cam lever will not be folded down when opening the breech.

After each number has completed his work as above, he takes up his position under cover as follows; they should then, if possible, be sitting or lying down:—†

"Gun Captain."—Where he can best regain his position for superintending the working of the gun.

"Gun Layer."—In rear of the slide when possible.

"Nos. 2, 4, and 10."—On the right of the gun.

"Nos. 3 and 5."—On the left of the gun.

2 and 3 being next the muzzle, 4, 5, and 10 outside them.

"Nos. 6, 9, 11, and 12."—At the head of the cartridge lift, or outside cartridge expense store.

"Nos. 7 and 8."—At the head of shell lift, or outside shell expense store.

* If the gun is fitted with a D percussion lock as the raising of the cam lever cocks the lock, the lever should not be folded down, when the breech is closed, 2 seeing that the breech-block is turned into its proper position.

† But they may be locally arranged for otherwise, so long as the men know exactly where to go, and are near enough to spring from thence rapidly to their work. Also see note §, page 73.

To Load.

*Gun Loaded in Firing Position.**Group Officer.*"..... *Group.*""*..... *Load.*"*Gun Captain.*"..... *Gun.*""..... *Load.*"

The Gun Layer mounts on to slide and adjusts his tangent sight approximately to the range shown on the indicator dial or other means of passing ranges, or as ordered by the Group Officer, as the case may be, and to the deflection given by the Group Officer, keeping clear of the working of the gun.

When P.F. is used he does not touch the tangent sights, but connects up the electric lanyard to a tube.

2 and 3 mount on to the slide and open the breech (if it has been closed after examining the gun) as before detailed; 2 and 3 receive the loading tray from 4 and 10, and place it in the chamber; when the loading tray is in two parts, 2 receives the front portion, 3 the rear, attach them and push them into the chamber.

4 supplies the loading tray; when it is in two parts 4 supplies the front and 10 the rear portion.

7 and 8 bring up the projectile on its barrow, 5 attends to the derrick, 8 hooks the derrick tackle to the selvagee or sling, 7 and 8, manning the winch handle, raise the projectile, 5 steadying it, and when high enough swinging it in towards the breech of the gun by the derrick lever; 2 and 3 then steady and guide the projectile, and when over the loading tray 3 holds up his hand as a signal for the numbers to ease off; as soon as the projectile is lowered on to the tray, 2 casts loose the selvagee or sling, 3 uncaps the fuze or removes the safety pins, 5 swings the derrick clear, 4 supplies the rammer to 2 and 3; the rammer is manned by 2, 4, and 8 on the right, 3, 5, and 7 on the left side; the projectile is then rammed home.† When home 2 and 3 raise their arms, spring the rammer, and lay it down on the slide.

2 and 3 then withdraw the shot loading tray and hand it to 10, 4 supplying the cartridge tray, which is placed in the bore by 2 and 3.

6, 9, 11, and 12 bring up the cartridges in zinc cylinders with lids unscrewed on each side of the slide, 6 and 12 on the right, 7 and 9 on the left side, withdraw them from the cylinders and hand them to 2 and 3 who place them in the chamber separately, pushing them home by hand or using the rammer if necessary, 3 removes the shalloon patch from end of last cartridge, withdraws the cartridge tray, assisted by 2, and hands it to 4, who, with 10, replaces it and the rammer; the breech is then closed as before detailed.

* "Palliser," "Common," "Case," or "Shrapnel," as the case may be, the Group Officer giving the nature and length of fuze if required.

† Should the projectile be "not home," 2 and 3 raise their arms and wave their hands twice across; the projectile is then forced home.

Gun Loaded when Run Back.

No. 4 elevates the gun into the loading position, and the loading is proceeded with as detailed before, 4 depressing the gun to enable the breech-block to be inserted. As soon as the breech is closed, the Gun Captain gives the signal "Run up," by raising both hands vertically above his head; at this signal 10 raises the running up lever on the right side of the slide, which allows the gun to run up.

NOTE.—The tube will not be put into the vent by the Gun Layer until the gun is run up.

Making Ready, Elevating, and Traversing.

As soon as the breech has been closed, the Gun Layer puts a tube in the vent,* hooks the lanyard,† and throws it over the end of slide, being careful to note that the guide bolt of the lock is home in the cam groove. He then proceeds to lay his gun.

When P.F. is used he puts in the electric tube, and takes care that the lanyard is clear of the slide, so as not to be cut by gun carriage on recoil.

2, 3, 9, and 10, assisted by 5 and 8 if required, man the traversing handles, 4 the elevating wheel.

The remaining numbers go under cover.

The Gun Layer gives directions to the elevating number in a low tone when tangent scales are used, but when Q.E. is used and the elevating number cannot read it, the Gun Captain signals to him as follows:—

"Elevate."—He holds up either hand, fingers pointing upwards.

"Depress."—He turns his hand, so that the fingers point downwards.

"Halt."—He slaps his thigh.

For direction the Gun Layer gives the following signals to the traversing number:—

"Trail Right or Left."—He motions with his hand, his fingers pointing in the required direction so as to be best seen by the traversing numbers.

"Halt."—He slaps his thigh.

*Laying and Firing.**Case I.**I.—When Elevation and Direction are given by Tangent Scale.*

The Gun Layer lays his gun with the deflection ordered and the elevation as shown on indicator dials or other means provided for passing ranges or as ordered by the Group Officer, altering it now and then as the dial or other means alter, or as ordered by Group Officer, as the case may be, until the final range is given, as follows:—

* The tube is never to be inserted before the breech is properly closed, under any pretext whatever.

† If the gun is fitted with an A lock, the Gun Layer will hook both the cocking and firing lanyards.

Final Range.

<u>Group Officer.</u>	<u>Gun Captain.</u>
"..... Group."	
or	"No. Gun."
"..... Gun."	
"..... Yards, LAY."	"..... Yards, LAY."

At the order "LAY," the Gun Layers, or only that of the gun named, as the case may be, adjust the tangent sight to the exact elevation ordered.

NOTE.—If a gun or guns of a group are to be fired as soon as possible after being loaded, the Group Officer should give the final range immediately the loading is completed. When firing at a stationary target the gun layer, as soon as he has received the final range and laid his gun, descends from the slide, and goes under cover; the elevating and traversing numbers doing the same, until the group officer gives the order "... Group" or "No. ... Gun, commence firing."

Commence Firing.

<u>Group Officer.</u>	<u>Gun Captain.</u>
"..... Group."	(on seeing that the Gun Layer
or "..... Gun."	has descended off slide)
"Commence Firing."	"..... Guns Fire."

At the order "Commence Firing" the Gun Layers of the group or of the gun named will make any final correction of the laying that may be necessary, fold down the cam lever, or with an A lock, cock the lock and descend from the slide.

As soon as the Gun Layer has descended from the slide, 4 clamps the elevating gear, seizes the lanyard,* and on the order "Fire" from the Gun Captain, fires; 2, 3, 9, and 10 remain on the traversing handles until the gun is fired.

NOTE.—In case of a missfire (i.e., the tube not being fired) the Gun Layer, after a pause of half a minute, will mount on to the loading stage and recock the lock by raising and lowering the cam lever (with an A lock 4 recocks with cocking lanyard). On another missfire the tube should be extracted and the lock examined by the Gun Layer.

In the event of a tube firing but failing to ignite a charge, after a pause of a minute the tube must be extracted by the Gun Layer, and another one inserted.

Under no circumstances should the breech be opened with the tube in the vent.

Case II.

II.—When using sighting steps, straight edged sights, and quadrant elevation.

The Gun Layer having folded down the cam lever,† stands on the sighting step, and keeps his gun trained on the target, laying only for direction.

* For electric firing see page 98.

† Or with an A percussion lock, cocked the lock.

4 elevates or depresses to the elevation ordered by the Gun Captain, reading the quadrant elevation, unless means are provided which he can read himself, when he will take it from such means.

The "elevation ordered" will be that shown on the indicator dial, or other means of exhibiting ranges, or as ordered by the Group Officer as the case may be. (For electric firing see page 98).

Final Range.

<u>Group Officer.</u>	<u>Gun Captain.</u>
" Group."	" Gun."
or	
" Gun."	" Yards, Lay."
" Yards, Lay."	

At the order "Lay," 4 carefully gives the final elevation ordered, directed if necessary by the Gun Captain, seizes the lanyard and stretches it taut.

Commence Firing.

<u>Group Officer.</u>	<u>Gun Captain.</u>
" Group."	(on getting signal from Gun Layer.)
or	
" Gun."	" Gun, Fire."
" Commence Firing."	

At the order "Commence Firing," the Gun Layer will rapidly make any final correction of the laying, and hold up his right hand over his head when on the target. He remains when possible on the sighting step; 4 fires the gun on the order "Fire" from the Gun Captain.

2, 3, 9, and 10 remain on the traversing handles until the gun is fired.

Case III.

III.—With quadrant elevation and training arc.

4 elevates or depresses as in Case II, except that when P.F. is used he gives the elevation as called by the dial number.

The Gun Layer reads the training by pointer as given by Group Officer or otherwise (or with P.F. by the dial number), and directs the traversing numbers as required.

Final Range.

At the order from the Group Officer or "dial number," "Range yards. Training degrees, Lay," 4 gives the exact elevation called out, directed if necessary by the Gun Captain, and goes under cover; unless when firing is not with P.F., when 4 seizes the lanyard or connects up wires to firing battery. The Gun Layer, with the help of 2, 3, 9, and 10, gives the exact training, and goes under cover; 2, 3, 9, and 10 remaining on the handles.

Commence Firing.

The Gun Captain satisfies himself that the gun is laid on the proper target.

If P.F. is not used, the words of command will be as in Case II, and 4 will fire on the Gun Captain giving the word.

Firing with P.F.

But when firing by P.F., the Gun Captain puts in the firing plug and runs to the rear of the slide, where he can best be seen by the Group Officer, holding up in his hand in line with his shoulder; he must, however, inform the Group Officer, if he cannot be seen by him, by word of mouth, signal, or as may be most convenient.*

When the Group Officer gives to the dial number the word or signal "*Commence Firing*," he goes under cover.

Scraping and Sponging Out.

As soon as the gun is fired the Gun Captain removes the firing plug if P.F. is used; 2 and 3 open the breech, the Gun Layer unhooks the lanyard, extracts the old tube and rimes out the vent (with P.F. coils up the lanyard and puts it in the firing plug box). When using brown powder, 4 supplies the scraper with brush to 3, and if necessary the sponge (wetted) to 2.

3 scrapes and brushes out the residue left from the previous round, being careful that the threads in the breech are not choked with it.

If necessary 2, assisted by 3, sponges out, taking the same precautions; 4 replaces the scraper and sponge.

To Unload at Drill.

The gun is unloaded by the same numbers as loaded it, 4 and 10 supplying the necessary sidearms and trays.

As soon as the gun is unloaded, 4 supplies 3 with scraper, and 3 scrapes and brushes out chamber as before detailed.

To Cease Firing and Replace Stores.

<i>Group Officer.</i>	<i>Gun Captain.</i>
"..... Group."	".... Gun."
"Cease Firing and Replace Stores."	"Cease Firing and Replace Stores."

The Gun Captain sees that Nos. 4 and 5 depress till the gun is at an angle of about 4°. The stores are replaced by the numbers who brought them up. After replacing stores the detachment falls in two-deep in rear of slide, as at first.

* Should a fresh prediction be necessary before the Group Officer orders "*Commence firing*," the Gun Captain will remove the firing plug, and the service of the gun will continue as before.

To Run Back, Take Post Under Cover, and Form Detachment Rear.

As in Drill for Mark II Mounting.

DRILL FOR 10-INCH B.L. GUN ON H.P. MOUNTING.

Gun Detachment.

The gun detachment consists of a Gun Captain (No. 1),* a Gun Layer, and 11 other gun numbers.

It falls in two deep, the Gun Captain being on the left of the front rank, the Gun Layer covering him.

† To Tell Off.

Group Officer.

Gun Captain.

"..... *Group Tell Off.*"

"..... *Tell Off.*"

At "*Tell Off.*" the Gun Captain takes a pace to his front, turns to his right, and gives the word "*Tell Off.*"

The Gun Layer does not number.

The right-hand man of the rear rank numbers 2, the right-hand man of the front rank 3, the second man from the right of the rear rank 4, his front rank man 5, and so on.

After the detachment is told off, the Gun Captain falls in again on the left of the front rank.

The detachment is then moved into the work and halted facing the mounting and in rear of it, or to such other convenient position under cover as the Group Officer may direct.

N.B.—When without a Group Officer, the directions, cautions, and commands laid down in this drill to be given by the Group Officer, will be given by the Gun Captain.

General Duties.

"The Gun Captain" ‡ (No. 1) commands, and is responsible to the Group Officer for the regular and efficient service of the gun in all respects. §

When at practice he is responsible to the Group Officer that his gun is laid on the target ordered.

* See footnote §, page 70.

† This should be done as far as possible on private parade, before marching off from parade, camp, or quarters.

‡ It is recommended that, when feasible, this Non-commissioned Officer should have permanent charge of the gun, and be responsible for its condition and cleanliness, and all stores, &c., connected with it, and also for the emplacement in which it is mounted.

§ When Q.E. is used, or training by arc and pointer, he must especially see that the numbers concerned are exact in their work.

When his gun is fought by position finder he will insert the firing plug after the gun is laid.

Reads and gives quadrant elevation (Q.E.) to elevating number.

When time fuzes are employed he sets them.

The Gun Layer.—His special duty is the laying of the gun.

When direction is given by training arc, he reads the training and directs the traversing numbers.

He attends to the vent and percussion lock and makes ready.

"No. 2."—Attends to cam lever, withdraws and cleans breech-block assists 3, with loading trays, steadies and guides projectile, hooks and unhooks hoisting tackle, removes selvagee or sling, rams home, inserts breech-block, traverses and sponges (if necessary).

"No. 3."—Attends to ratchet lever, unlocks and assists 2 to withdraw breech-block,* places loading trays, steadies and guides projectile, uncaps fuze or removes safety pins, loads, removes shalloon patch from end of last cartridge, rams home, removes the loading trays, assists to insert breech-block, traverses, removes residue from chamber and mushroom head with scraper and brush after every round, and assists 2 to sponge (if necessary).

If the gun is fitted with control gear, 3 withdraws and inserts the breech-block by its means.

"No. 4."—Supplies loading trays and sidearms, rams home, elevates and fires.

"No. 5."—Attends to hoisting tackle, raises projectile, rams home, assists to insert breech-block if required, runs up and elevates.

"No. 6."—Attends outside the cartridge expence store and supplies cartridges to 3, removing empty cylinders.

"No. 7."—Attends outside the shell expence store, fixes fuzes, brings up and raises projectile, rams home if required, and removes empty barrow.

"No. 8."—Assists 7 in all duties, brings up and raises projectile, and rams home if required.

"No. 9."—Assists 6 in all duties, and traverses.

"No. 10."—Assists 4 to supply sidearms and loading trays to 2 and 3, and traverses.

Nos. 11 and 12 assist 6 in all duties.

To Prepare for Action and Examine Gun.

Group Officer.

Gun Captain.

"Prepare for action and Examine Gun."

"Prepare for action and Examine Gun."

At "Prepare for Action" each number brings up his stores† as under:—

Gun Layer.—Gun, mirror, and shield sights as ordered, tubes, two lanyards (cocking and firing), rimer, tube extractor, percussion lock, and spare strikers (for drill purposes a drill tube).

"No. 2."—Side arms (consisting of sponge, rammer, and scraper with brush), and loading tray or trays.

* If the gun is fitted with control gear, 3 withdraws and inserts the breech block by its means, and 2 and 3's duties will be altered accordingly.
† Some of these stores may be already on the gun.

"No. 3."—Pressure indicator and spanner, key for muzzle tampeon oil can, Russian tallow, and waste.

"No. 4."—Assists 2 with sidearms, and loading tray or trays.

"No. 5."—Hoisting tackle and handle for lowering pump.

"No. 6, assisted by 9, 11, and 12."—Bucket filled and brush, and for drill purposes four zinc cylinders with drill cartridges.

"No. 7, assisted by No. 8."—Transporting barrow, two slings or salvages, fuzes, fuze and shell implements, and piece of chalk. (For drill purposes a drill shell.)

"No. 10."—Assists 2 and 4 with sidearms and loading trays.

The stores having been brought up and found correct, the covering plates will be removed by the detachment; the Gun Captain will then give "*Examine Gun*," and see—

That the automatic cut off gear is in adjustment and in good order.*

That the holding down clips or bolts are disconnected.

That the roller path is clean.

He will attach the pressure indicator, test the pressure in cylinder, and test level of liquid.†

He will receive the fuze key from 7.

He receives reports from the numbers responsible of any irregularity or deficiency in connection with the different parts of the gun, mounting, and stores.

As soon as the breech has been opened by 2 and 3, he looks through the bore and sees that it is clear.

When firing by P.F. he sees that the firing plug is ready for use, and the electric lanyard attached to the proper binding screws.

When firing by electricity he will be responsible that the firing battery and wires are correct and ready for use.

The Gun Layer receives the tubes from the shell store, he coils up the lanyards, placing them with the extractor, rimer, and tubes in a recess or other convenient position in the emplacement or mounting, and having examined the lock, places it in position in the breech-block. He then fires a tube,‡ sees that the lock is in good working order, and rimes out the vent.

When P.F. is used he coils up the electric lanyard and places it in the firing plug box clear of the detachment.

He fixes the gun sights in the gun, taking care that the fore-sights fit properly, and the deflection leaves of the hind-sights work easily. He places the mirrors, when used, in their frames, being careful to observe that they are properly secured by the spring clips, and that the wires are adjusted to agree with the tangent sight; he also fixes the shield sights and sees that the pointer for training arc is let down to position for reading training. He then takes up his position under cover.

No. 2 arranges side arms and sees that the traversing gear is oiled and in working order, and disconnects the holding down clip or bolt on his own side.

No. 3 removes muzzle tampeon and breech apron, and disconnects the holding down clip or bolt on his own side.

No. 4 assists 2 to arrange sidearms, and sees that the elevating gear is oiled and in good working order.

* This must be noted when the gun is in the firing position.

† For method of charging and testing cylinders, *vide* Handbook.

‡ N.B.—Before firing the tube, the Gun Captain will see that no one is in front of the muzzle (see notes on tubes, &c., on page 64).

Nos. 5, 7, and 8 place the stores they have brought up in a convenient position for use. At drill the drill shell is to be placed outside the shell expense store.

Nos. 6, 9, 11, and 12 place bucket of water and brush near head of sidearms, also loosen or remove bands from covers of cylinders as required, if not already done. At drill they place the cartridge cases or cylinders with drill cartridges outside cartridge expense store.

No. 10 assists 2 and 4 to arrange sidearms and loading trays.

The breech will then be opened by 2 and 3.

Opening and Closing the Breech.

2 raises the cam lever into its upright position, 3 raises the ratchet lever to its full extent, sees that the ratchet catches, and with both hands forces it sharply down till the cam lever is against the stop. 2 then starts the movement of the breech block by lowering the cam lever, raising it into its upright position again, and, assisted by 3, withdraws the breech-block, and swings it round until the carrier ring is caught by the latch on the right side of the gun.

2 then examines the breech-block and sees that it is clean and the threads free from burrs, lubricating them with a slight film of oil, and rubbing the asbestos pad with Russian tallow or grease; 3 examines the bore, chamber, and threads of breech, also lubricating the threads with a slight film of oil if necessary.

"To close the breech," 2 releases the spring latch, and, assisted by 3 (and 8 if required), swings the breech-block round and pushes it home, 2 (and 8) holding it in this position whilst 3 locks it by working the ratchet lever until the cam lever can be folded down by 2. The ratchet lever is then released by 3, and allowed to fall down into its place.

If the gun is fitted with control gear, 3 withdraws and inserts the breech-block; in this case the cam lever will not be folded down by 2 when opening the breech.

If a D percussion lock is used, as the raising of the cam lever cocks the lock, the lever should not be folded down when the breech is closed, 2 seeing that the breech-block is turned into its proper position.

After each number has completed his work as above he goes under cover.

The position of the various numbers under cover is as follows. They should then, if possible, be sitting or lying down.*

"Gun Captain."—Where he can best regain his position for superintending the working of the gun.

"Gun Layer."—In line with the breech of the gun on the right side.

2, 4, and 10 on the right side of the gun; 3 and 5 on the left.

2 and 3 being next the muzzle, and 4 and 10 outside 2, and 5 outside 3.

7 and 8 outside the shell expense store.

6, 9, 11, and 12 outside the cartridge expense store.

But they may be locally arranged otherwise so long as the men know exactly where to go, and are near enough to spring rapidly to their work.

* It is permitted, at the option of the Instructor, for the detachment to be standing or sitting down when at drill.

To Load.

<i>Group Officer.</i>	<i>Gun Captain.</i>
"..... <i>Group or Gun.</i> "	"..... <i>Gun.</i> "
*"..... <i>Load.</i> "	*"..... <i>Load.</i> "

The "Gun Layer" adjusts his tangent sight approximately to the range shown on the indicator dial or other means of passing the ranges, or as ordered by the Group Officer, as the case may be, and to the deflection given by the Group Officer.

When P.F. is used he does not touch the tangent sight, but connects up the electric lanyard to a tube.

2 and 3 open the breech (if it has been closed after examining the gun) as before detailed; 2 and 3 receive the loading tray from 4 and 10, and place it in the chamber. When the loading tray is in two parts, 2 receives the front, 3 the rear portion, attach them, and push them into the chamber.

4 supplies the loading tray. When it is in two parts, 4 supplies the front and 10 the rear portion. 7 and 8 bring up the projectile on barrow, 2 hooks the lower block to selvage or sling; the running end of the fall is manned by 5, 7, and 8. 2 and 3 steady, while raising, and guide the projectile on to loading tray. 2 casts loose lower block and selvage or sling, 3 uncaps the fuze or removes the safety pins; 4 then supplies the rammer to 2 and 3. The rammer is manned by 2, 4, and 8 on the right, and 3, 5, and 7 on the left side; the projectile is then rammed home.† When home, 2 and 3 raise their arms, 2 springing the rammer and laying it down behind him. 2 and 3 then withdraw the shot loading tray and hand it to 10, 4 supplying the cartridge tray, which is placed in the bore by 2 and 3, if separate trays are used. 6, 9, 11, and 12 bring up the cartridges in zinc cylinders, with lids unscrewed; 2 and 3 withdraw them from the cylinders and place them in the chamber separately, pushing them home by hand, or using the rammer if necessary. 3 removes the shallow patch from end of last cartridge, withdraws the cartridge tray and hands it to 4, who, with 10, replaces it and the rammer; the breech is then closed as before detailed. The "Gun Layer" then puts a tube in the vent.‡

NOTE.—When using Q.E. and mirror sights, and firing by percussion tubes, the cocking and firing lanyards will be attached before the gun is run up, the lanyard being passed and allowed to hang over the shield, care being taken that it cannot possibly catch as the gun is run up.

To Run Up.

<i>Group Officer.</i>	<i>Gun Captain.</i>
"Run up."	"Stand clear." "Run up."

5 presses down the lever of raising valve as far as it will go towards "Open," and lets go of the lever. He permits the gun to rise

* "Palliser," "Common," "Case," or "Shrapnel," as the case may be, the Group Officer giving the nature and length of fuze if required.

† Should the projectile be "not home," 2 and 3 raise their arms and wave their hands twice across; the projectile is then forced home.

‡ The tube is never to be inserted *before* the breech is properly closed, under any pretext whatever.

until he hears a click* in the interior of the cylinder, which tells him that the gun is fully up. He then completes the closing of the valve by raising the lever as far as it will go.

NOTE.—When P.F. is used the Gun Layer puts in the electric tube before running up, and takes care that the lanyard is clear of the mounting, so as not to be cut when the gun recoils.†

Making Ready, Elevating, and Traversing.†

As soon as the gun has been run up, the Gun Layer mounts on to the laying step, hooks one lanyard to the firing bolt and the other to the hammer of the percussion lock, and throws them over the shield in rear of breech of gun, being careful to see that the guide bolt of the lock is home in the cam groove, and proceeds to lay his gun.

2, 3, 9, and 10 man the traversing wheels, 4 and 5 the elevating wheels.‡

The "Gun Layer" gives directions to elevating and traversing numbers by word of command or signal.

If Q.E. is used, the Gun Captain directs the elevating numbers

NOTE.—For signals see page 84.

Laying and Firing.

Case I.

I.—When elevation and direction are given by tangent scale, or when straight-edged sights and Q.E. are used.

The Gun Layer lays his gun with the deflection ordered and the elevation as shown on indicator dials or other means provided for passing ranges, or as ordered by the Group Officer, altering it now and then as the dial or other means alter, or as ordered by the Group Officer, as the case may be, or 4 and 5 elevate or depress to the elevation ordered by the Gun Captain who reads the Q.E., until the final range is given as follows:—

Final Range.

Group Officer.	Gun Captain.
"..... Gun."	"..... Gun."
"..... Yards, LAY."	"..... Yards, LAY."

At the order "lay," the Gun Layer adjusts the tangent scale to the exact elevation named, or 4 and 5 give the elevation ordered.

NOTE.—If the gun is to be fired as soon as possible after being loaded, the Group Officer should give the final range immediately the gun is run up.

* This click is caused by the end of the ram coming against the top of the cylinder. (See also "Instructions for Erection and Working of H.P. Mountings," at page 42.)

† Note.—The gun may be roughly traversed into the line of fire, before or during running up, by 2 and 3 under the direction of the Gun Layer.

‡ With B.L. guns, mounted on H.P. mountings, the last motion of the elevating gear should be "elevation," and not "depression."

Commence Firing.

Group Officer.	Gun Captain.
—	—
"..... Gun."	(On seeing that the Gun Layer has descended the ladder and is clear of the recoil)
"Commence Firing."	"..... Gun, Fire."

At the order "*Commence Firing*," the Gun Layer rapidly makes any final correction of the laying that may be necessary, cocks the lock,* and comes down from the laying steps, noting that these are clear of the recoil. As soon as the Gun Layer has descended the ladder, and is clear, 4 seizes the firing lanyard, and on the order "*Fire*," from the Gun Captain fires. 2 and 3 remain on the traversing wheels until the gun is fired.

NOTE.—In case of a missfire† (i.e., the tube not being fired), 4 will recock the lock with the cocking lanyard; on another missfire, the tube should be extracted and the lock examined by the Gun Layer.

In the event of a tube firing but failing to ignite a charge, after a pause of a minute the tube must be extracted by the Gun Layer, and another one inserted.

Under no circumstances should the breech be opened with a tube in the vent.

Case II.

II.—When using mirror sights and Q.E.

The Gun Layer keeps the gun trained on the objective by looking in the lower mirror, laying only for direction.

4 and 5 elevate or depress to the elevation ordered under the direction of the Gun Captain, who reads the Q.E.

The "elevation ordered" will be that shown on the indicator dial or other means of exhibiting ranges, or as ordered by the Group Officer, as the case may be.

Final Range.

Group Officer.	Gun Captain.
—	—
"..... Gun."	"..... Gun."
"..... Yards, LAT."	"..... Yards, LAT."

At the order "*Lay*," the final elevation order is given by direction of the Gun Captain, 4 seizes the lanyards, cocking the lock by means of the cocking lanyard. (For electric firing, see page 98.)

Commence Firing.

Group Officer.	Gun Captain.
—	—
"..... Gun."	(On getting signal from Gun Layer)
"Commence Firing."	"..... Gun, Fire."

* With guns fitted with D percussion lock, the cam lever is folded down, in place of cocking the lock with an A lock.

N.B.—An arrangement of the mechanism is now under consideration, by which the Gun Layer can cock the lock without being obliged to ascend the laying steps.

† In case of a missfire with a D lock, the Gun Layer recocks the lock by raising and folding down the cam lever after a pause of half a minute.

At the order "*Commence Firing*," the Gun Layer will rapidly make any final correction of the laying, and hold up his right hand over his head when on the target; 4 fires the gun on the order "*Fire*" from the Gun Captain.

2 and 3 remain on the traversing wheels until the gun is fired.

Case III.

III.—*With quadrant elevation and training arc.*

The Gun Captain directs 4 and 5 to elevate or depress as in Case II, except that when P.F. is used, the elevation will be that called by the dial number, directed if necessary by the Gun Captain.

The Gun Layer reads the training by pointer, as given by Group Officer or otherwise (or with P.F. by the dial number), and directs the traversing numbers as required.

Final Range.

At the order from the Group Officer or "dial number," "*Range yards, Training degrees, Lay*," 4 and 5 give the exact elevation called out, directed by the Gun Captain, and go under cover, unless when firing is not with P.F., when 4 proceeds as in Case II.

The Gun Layer, with the help of 2, 3, 9, and 10, gives the exact training, and goes under cover, 2 and 3 remaining on the traversing wheels.

Commence Firing

The Gun Captain satisfies himself that the gun is laid on the proper target.

If P.F. is not used, the words of command will be as in Case II, and 4 will fire on the Gun Captain giving the word.

When firing by P.F., the Gun Captain puts in the firing plug and runs to the rear of the pit, or where he can best be seen by the Group Officer, holding up his hand in line with his shoulder.

N.B.—He must, however, communicate with the Group Officer if he cannot be seen by him, by word of mouth, signal, or as may be most convenient.*

When the Group Officer gives to the dial number the word or signal "*Commence Firing*," he goes under cover.

Scrapping and Sponging Out.

As soon as the gun is fired, the Gun Captain removes the firing plug if P.F. is used, 2 and 3 open the breech, the Gun Layer unhooks the lanyards, extracts the old tube and rimes out the vent (with P.F. coils up the electric lanyard and puts it in the firing plug box); 4 supplies the scraper with brush to 3, and, if necessary, the sponge (wetted) to 2.

* Should a fresh prediction be necessary, or the signal or order "*Stand fast*" be given before the Group Officer orders "*Commence firing*," the Gun Captain will immediately remove the firing plug, and the service of the gun will continue as before.

3 scrapes and brushes out the residue from the previous round, being careful that the threads in the breech are not choked with it.
If necessary 2 then sponges out, taking the same precautions;
4 replaces the scraper and sponge.

To Run Back and Unload at Drill.

As soon as the gun has been fired, the Gun Captain gives the order to "*Run Back.*"

5 ships* the handle of lowering pump, and, assisted by 2, 3, and 4, "*Run Back.*" As soon as the gun is down, the Gun Captain gives the word "*Halt,*" 5 unships the handle of lowering pump and replaces it.

2 and 3 open the breech, 3 withdraws cartridges and places them in case or cylinder, 2 takes hold of lanyard of drill shell and pulls it steadily out of the chamber far enough for the salvager to be placed over it by 5 and 7, who remove and replace it.

As soon as the gun is unloaded 4 supplies 3 with scraper, and 3 scrapes and brushes out the chamber.

To Cease Firing and Replace Stores.

Group Officer.

"Cease Firing and Replace Stores."

Gun Captain.

"Cease Firing and Replace Stores."

The stores are returned by the numbers who brought them up.

The Gun Captain sees that the holding-down clips or bolts have been connected, and that the raising lever is secured by chain and padlock.

After replacing stores the detachment falls in two-deep in rear of the gun, as at first.

"To take Post under Cover."

"To form Detachment Rear."

These movements will be required at times. They will be as follows:—

To take Post under Cover.

Group Officer.

"Take Post under Cover."

Gun Captain.

"Double March."

Each number doubles to his position as given on page 91.

To form Detachment Rear.

Group Officer.

"Detachment Rear."

Gun Captain.

"Double March."

* If not already there.

The Gun Captain doubles out and places himself on the left rear of the mounting facing to the front. On the word "*Double March*," the numbers double to their places in "*Detachment Rear*," halting and fronting as they come up.

DRILL FOR 10-INCH B.L. ON EASTON AND ANDERSON MOUNTING.

The drill is the same as that for the 10-inch on H.P. mounting, with the following exceptions:—

General Duties.

In Nos. 2 and 3's duties substitute "assists to place projectile on lifting tray and push it, when raised, on to loading tray," for "steadies and guides the projectile."

In No. 5's duties substitute "attends to lifting gear," for "attends to hoisting tackle."

In No. 7's duties substitute "places projectile on lifting tray," for "raises projectile."

To Prepare for Action and Examine Gun.

The detail relative to hoisting tackle brought up by 5, and slings or selvagees brought up by 7, is omitted.
5 sees that the lifting gear is oiled and in working order.

To Load.

2 and 3 elevate or depress the gun to a convenient position for loading.

The projectile is brought up by 7 and 8 on barrow, is tilted forward on to lifting tray by 7, assisted by 2, 3, and 8; 5 and 8 then man the winch handles and raise the projectile; when high enough 2 and 3 push the projectile from the lifting on to the loading tray, 3 uncaps the fuze or removes the safety pins, 5 and 8 allowing the lifting tray to run down by lifting the panels. (The remainder of the service of the gun is the same as with the Elswick mounting.)

Ammunition, Detail, &c.

In addition to the gun detachments, the following must be provided for according to local requirements:—Ammunition supply details, Depression Range Finder, Position Finder, Dial and Telephone details. Orderlies, &c., as required.

(7953)

Firing by Electricity.

When firing guns by electricity otherwise than with P.F., the Gun Layer, when preparing for action, will bring up the following stores in addition, viz. :—

A Leclanché battery and firing key in wooden box, and a Menotti battery with galvanometer attached (for testing tubes), or Holden's firing key (which combines a battery with the means of testing the circuit and firing), two insulated firing wires, each 8 to 10 yards in length.

These stores are placed close to the gun, and on one flank or in rear, but as convenient as possible for the firing number, and at the same time so as not to interfere with the working of the gun. The firing wires should be attached by a turn being taken with them to a convenient part of the mounting or gun, so that the weight of the wires shall not come on the tube when joined up to it; the other ends are led to the firing battery or key, and one of them attached to a terminal, sufficient slack being allowed for the running up or traversing of the gun. The tube will be joined to the firing wires* by the Gun Layer during the loading of the gun, and placed in the vent as soon as the breech is closed.

The method of firing is similar to that when using percussion tubes, except that in :—

"Case I."—4 connects up the 2nd line wire to the other terminal of the firing battery or key on seeing the firing signal† from the Gun Layer, and presses the firing key on the word "Fire" from the Gun Captain.

"Cases II and III."—4 connects up the 2nd wire as soon as the Q.E. has been given, and proceeds as in case I.

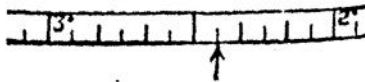
As soon as the gun is fired, 4 at once disconnects one of the firing wires from the battery or key.

NOTE.—When the tubes are tested before being put up into the vent, they should be placed clear of the detachment and in a safe position; if they are tested when in the vent immediately before firing, two or three short lengths of wire will be required in addition to the firing wires when using the Menotti testing battery.

Instructions for using the Large Clinometer.

To read the angles marked on the drum.—The brass drum is marked in degrees, commencing at 0° on the top to 45° at the bottom. Each degree is subdivided into twelve parts; each small division therefore represents angles of 5 minutes.

The scale is read from right to left, thus :—

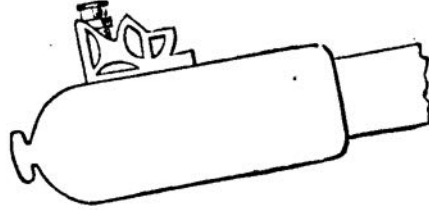


the reading opposite the arrow would indicate an angle of 2° 25'.

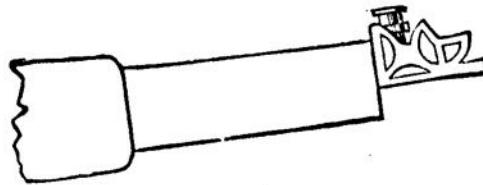
* If a B electric lock is used, one line wire will be attached to the tube, the other line wire to the insulated contact on the breech of the gun, the second tube wire being placed on to the terminal of the lock. (The earth terminal of this lock should be removed.)

† This signal with H.P. and Vavasseur mountings is the Gun Layer getting clear of the recoil, and with barbette or yoke mountings the Gun Layer dismounting from the slide.

To lay a gun or howitzer of any angle up to 45° .—Unscrew the drum until the \uparrow points to the elevation required, place the clinometer thus—

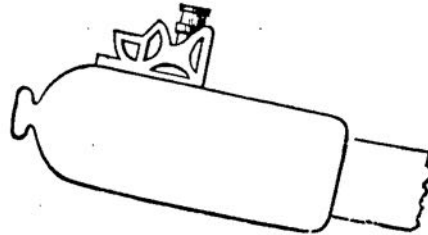


on the plane surface cut on the breech, or against the muzzle, thus—

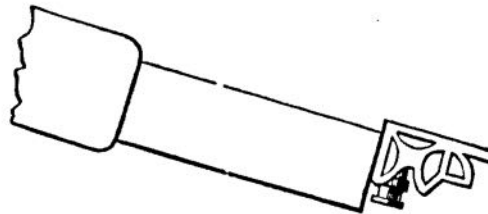


and elevate the piece until the bubble of the spirit level is in the centre of the tube.

For angles of depression.—Proceed as above, but reverse the direction of the instrument, placing it thus on the gun—



and thus on the muzzle—

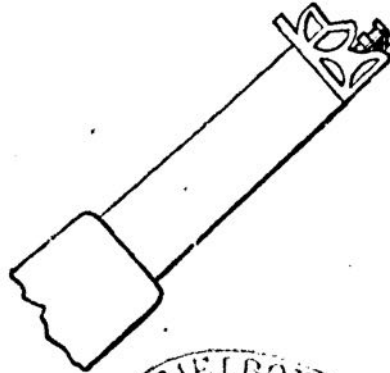


For angles of elevation greater than 45° .—Subtract the angle of elevation required from 90° , unscrew the drum to this reading; thus

for 60°, unscrew the drum to 30°, and place the instrument on the breech of the gun, thus—



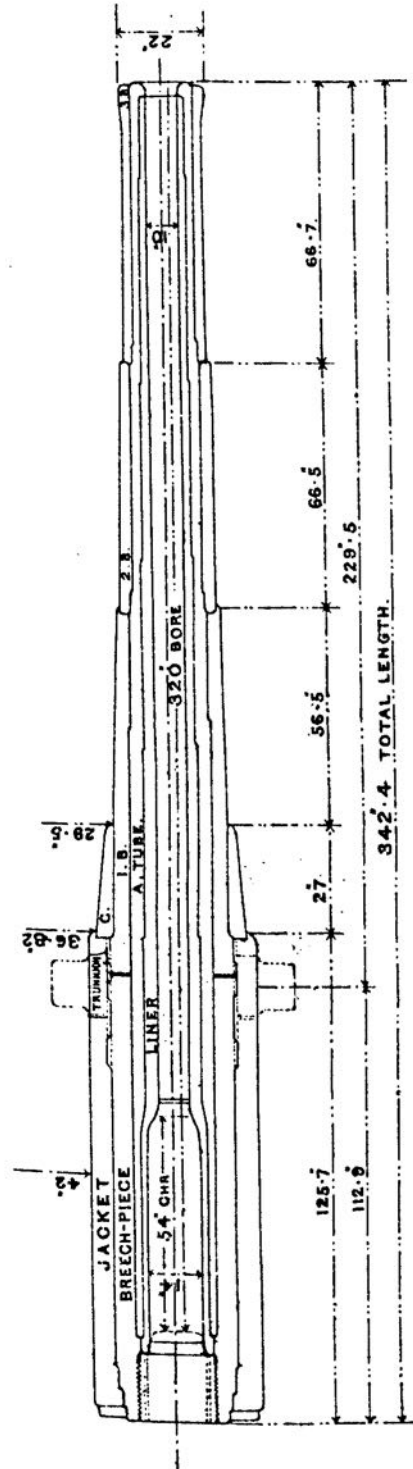
or on the muzzle, thus—



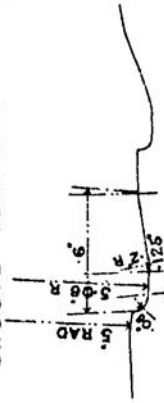
and elevate until the bubble is in the centre of its run.



ORDNANCE B. L. 10 INCH MARK I.
SCALE 50.

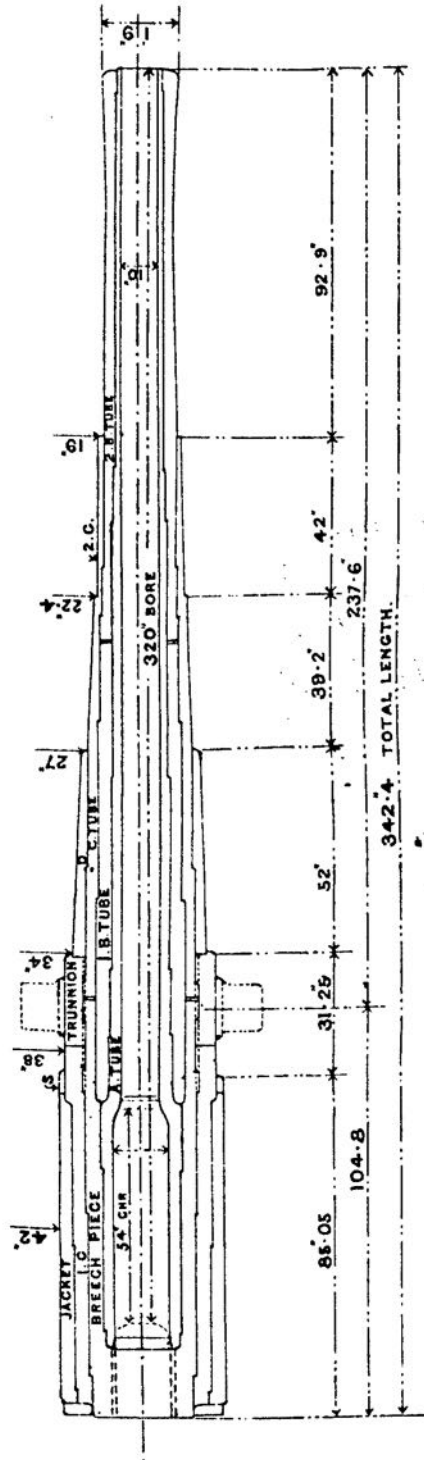


GROOVE FULL SIZE.



RIFLING AN INCREASING TWIST FROM 1 TURN IN 60 CALS AT BREECH TO 1 IN 30 AT MUZZLE.
N° OF GROOVES 40.

SCALE 50.



GROOVE - FULL SIZE.

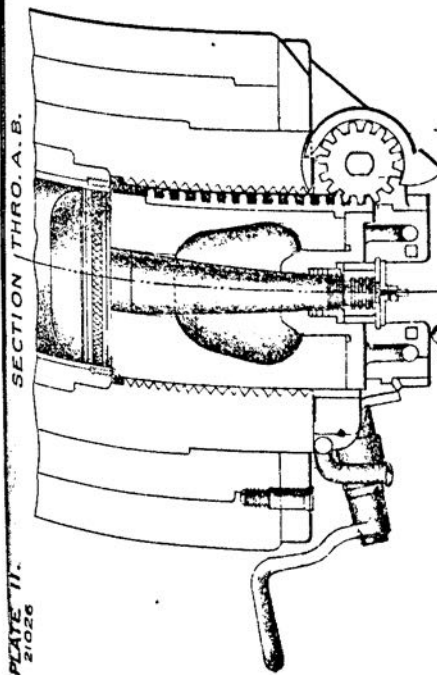
RIFLING AN INCREASING TWIST FROM 1 TURN IN 60 CALS AT BREACH TO 1 IN 30 AT MUZZLE.
 NO OF GROOVES 40.

BREECH CLOSING ARRANGEMENT FOR 10 INCH.
B. L. GUN MARK I.

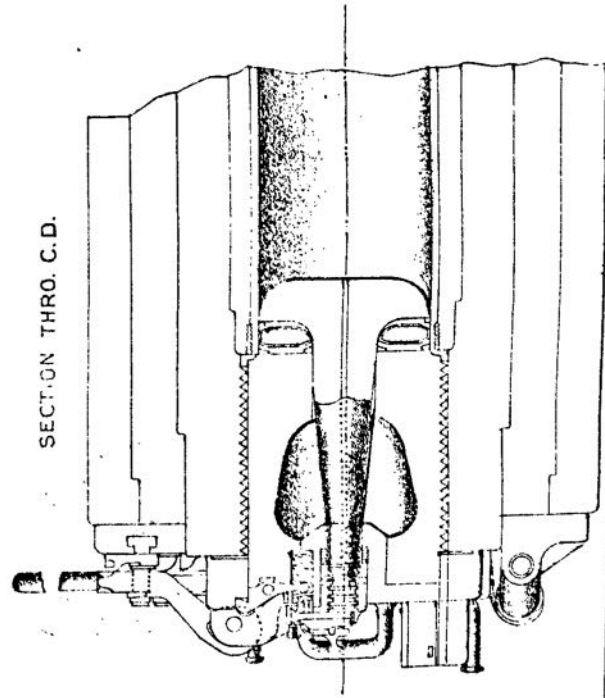
SCALE $\frac{1}{16}$.

SECTION SHEWING RADIUS IN BRONZE.
FRAME ON MARK I GUN.

PLATE II.
21026



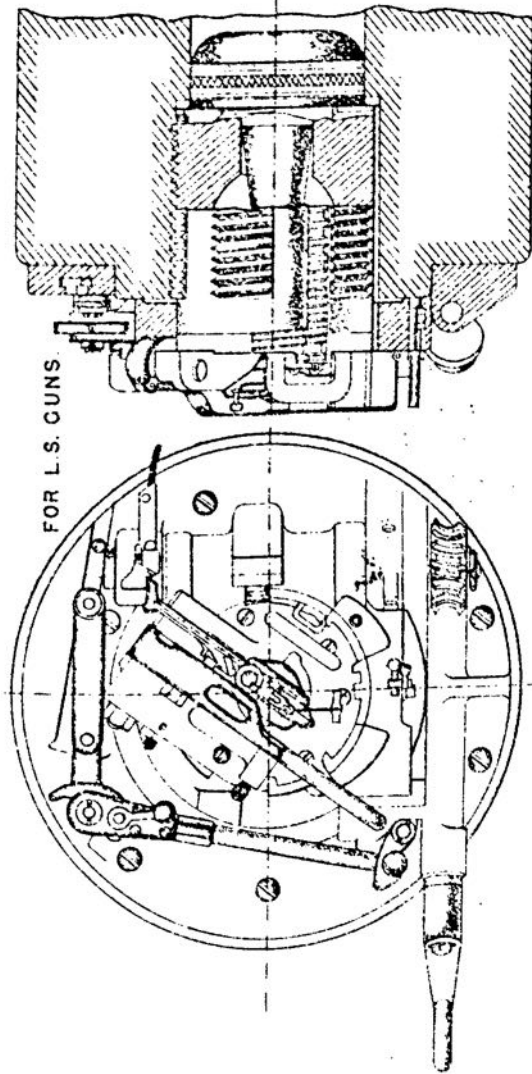
SECTION THRO. C. D.



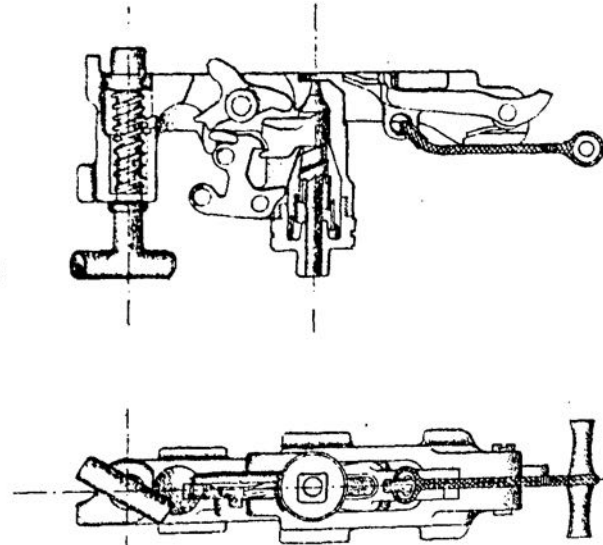
ORDNANCE B. L. 10-INCH MARKS II&III

BREECH CLOSING ARRANGEMENT.

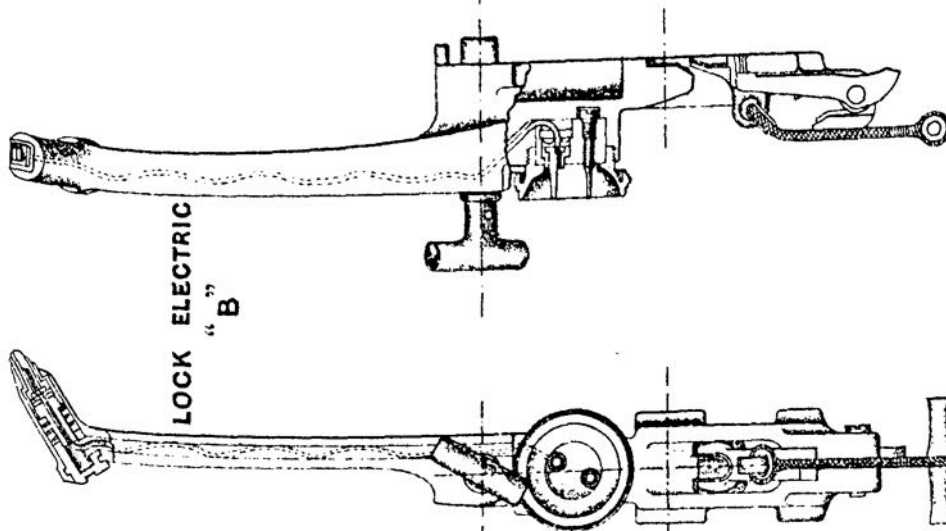
SCALE 1/8"



LOCK PERCUSSION
"D"



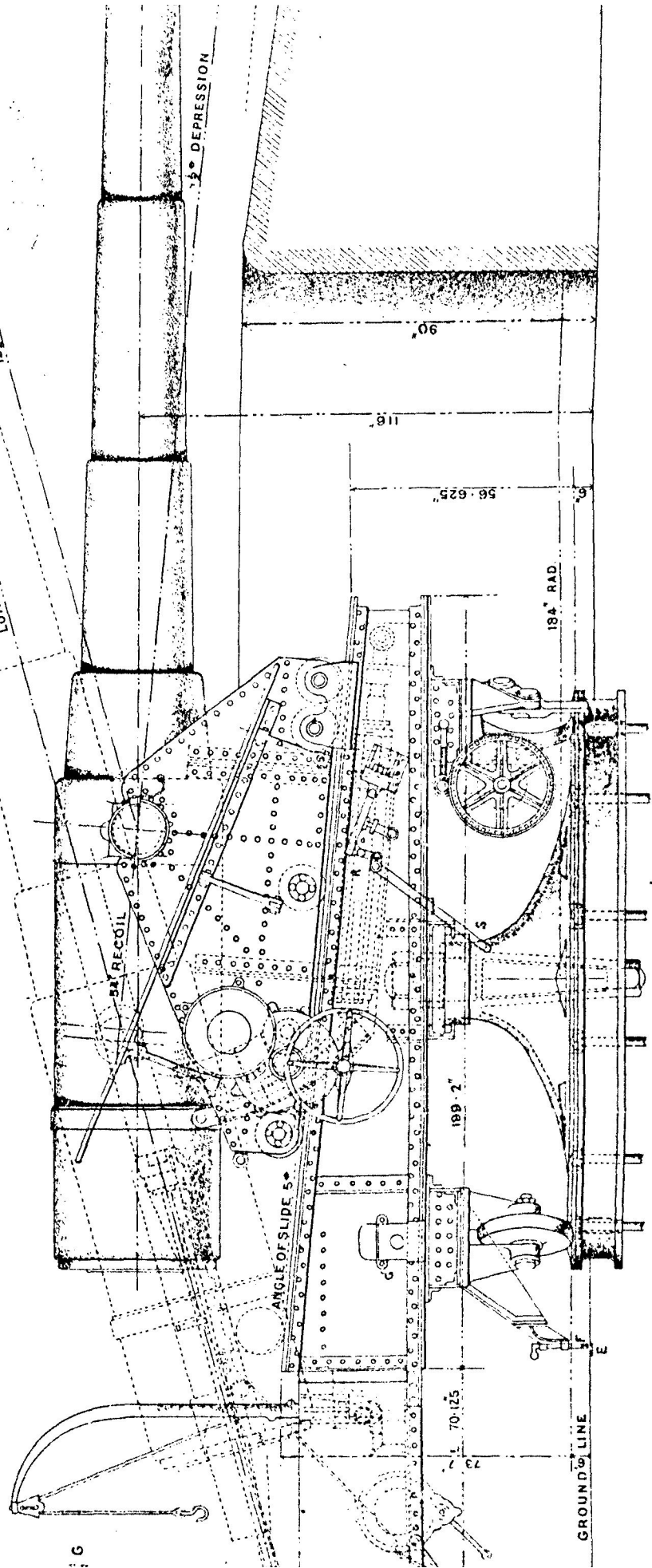
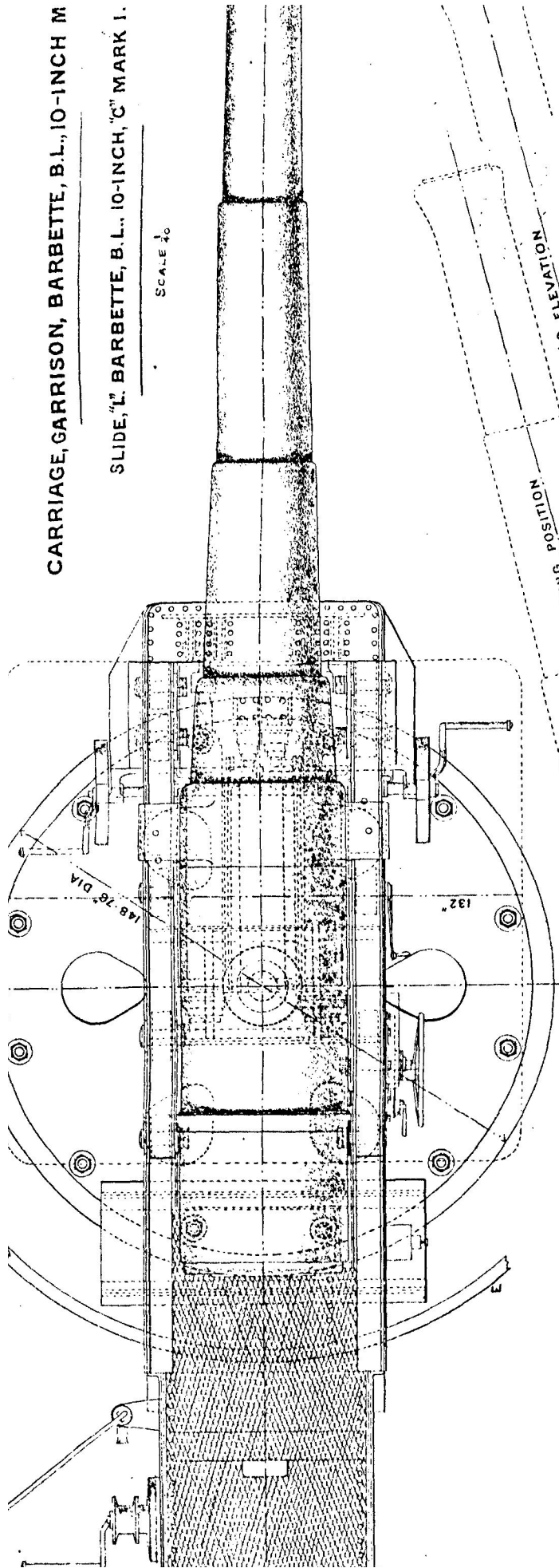
LOCK ELECTRIC
"B"



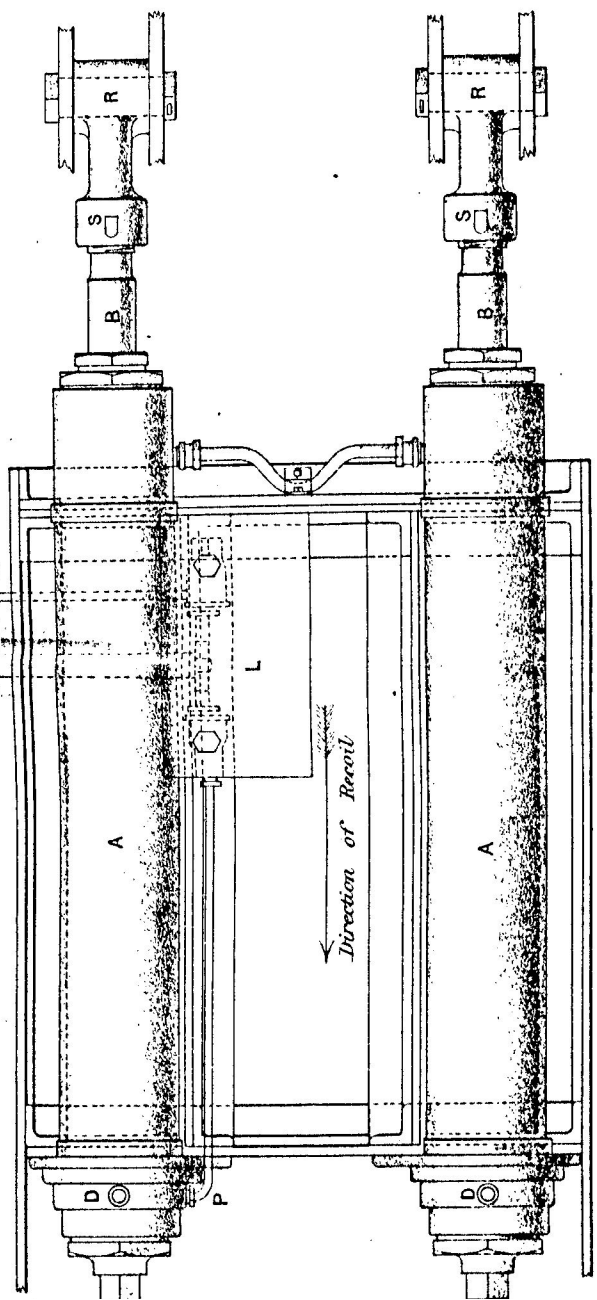
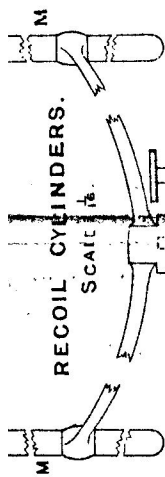
CARRIAGE, GARRISON, BARBETTE, B.L., 10-INCH M.

SLIDE, "L" BARBETTE, B.L., 10-INCH, "C" MARK I.

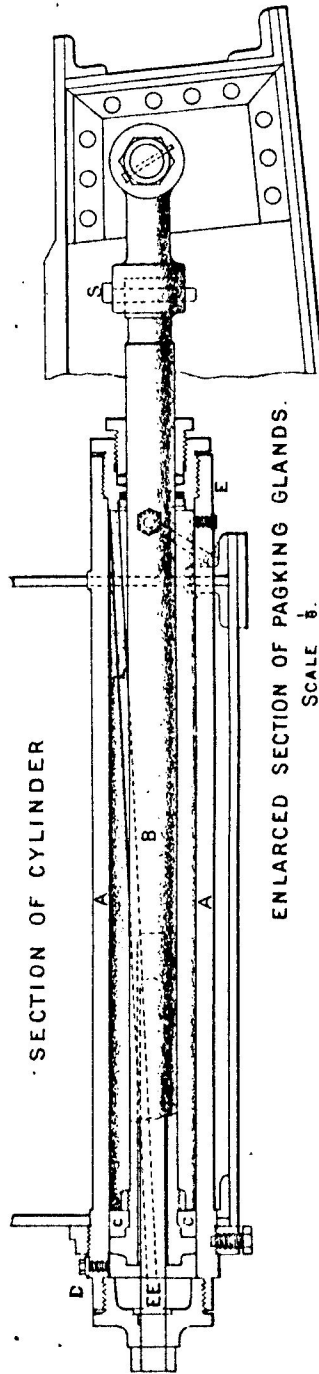
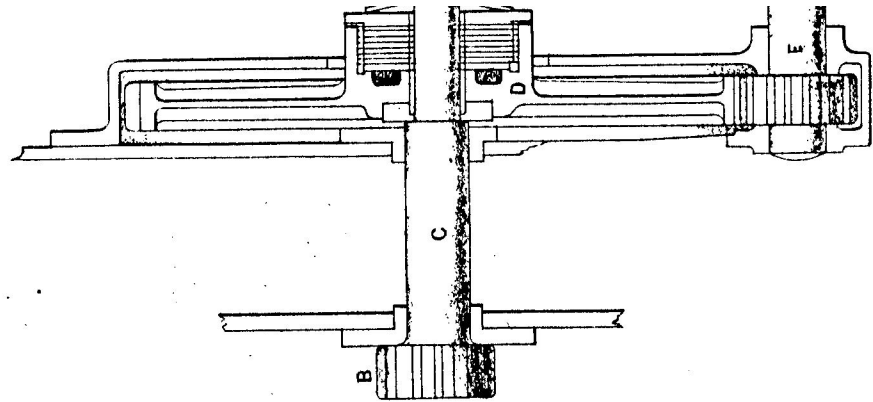
SCALE $\frac{1}{40}$



10 INCH BARBETTE MOUNTING, MARK I.

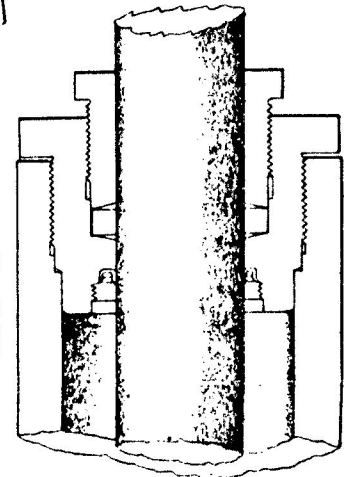


SECTION OF ELEVATION
SCALE 1/2"

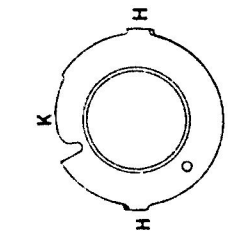


SECTION OF CYLINDER

ENLARGED SECTION OF PACKING GLANDS.
SCALE 1/2"



END VIEW OF VALVE C.



SCALE 1/2"

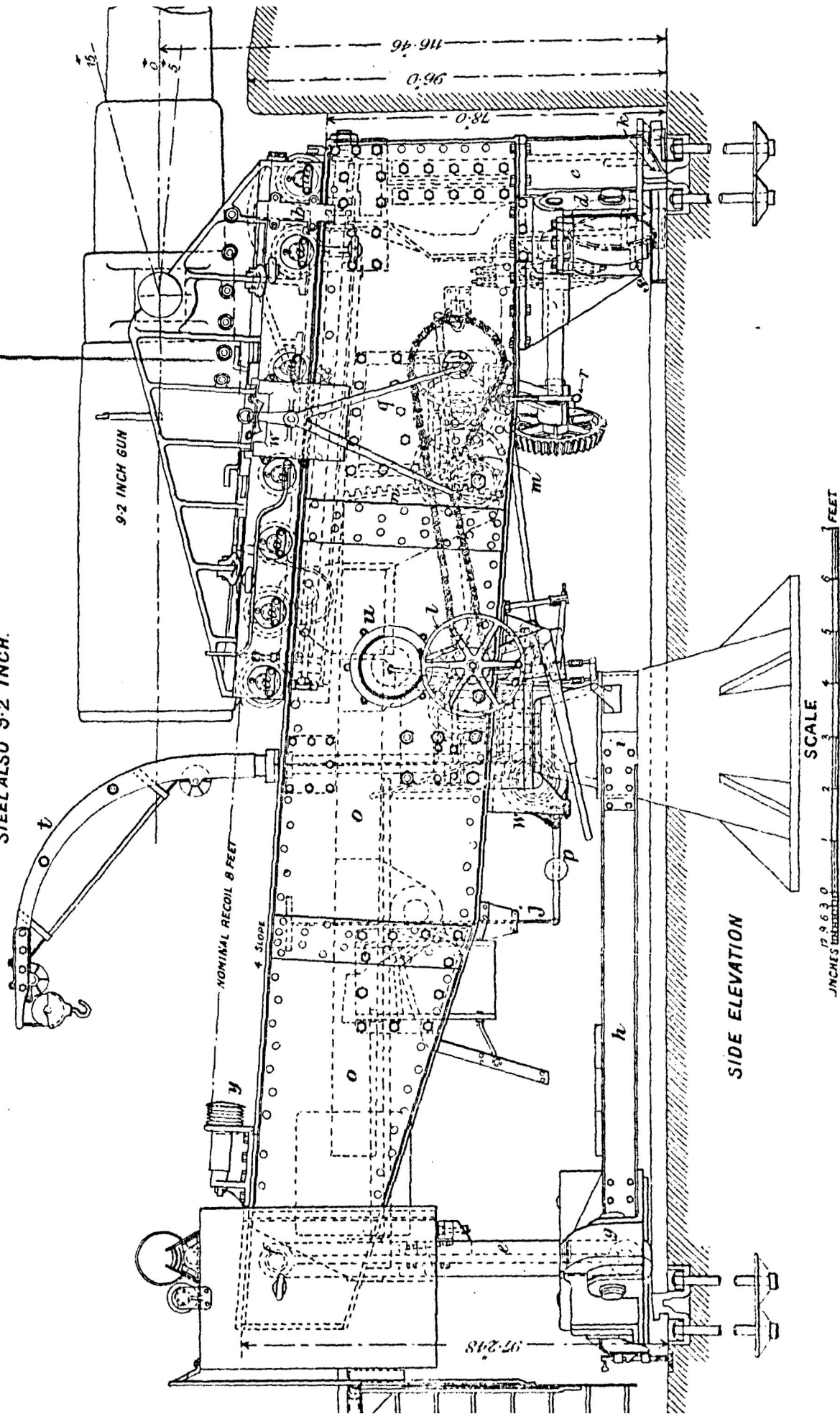
CARRIAGE, GARRISON, BARBETTE, B.L. 10 INCH. MARK II.

STEEL ALSO 9.2 INCH

SLIDE L BARBETTE B.L. 10 INCH MARK II

STEEL ALSO 9.2 INCH.

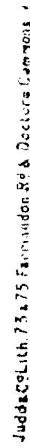
R.C.D.
4740
5889
ELEVATION.



R.C.D.
4740
5889
PLAN.

SLIDE, L. BARBETTE, B.L. 10 INCH. MARK II.

STEEL, ALSO 9.2 INCH.

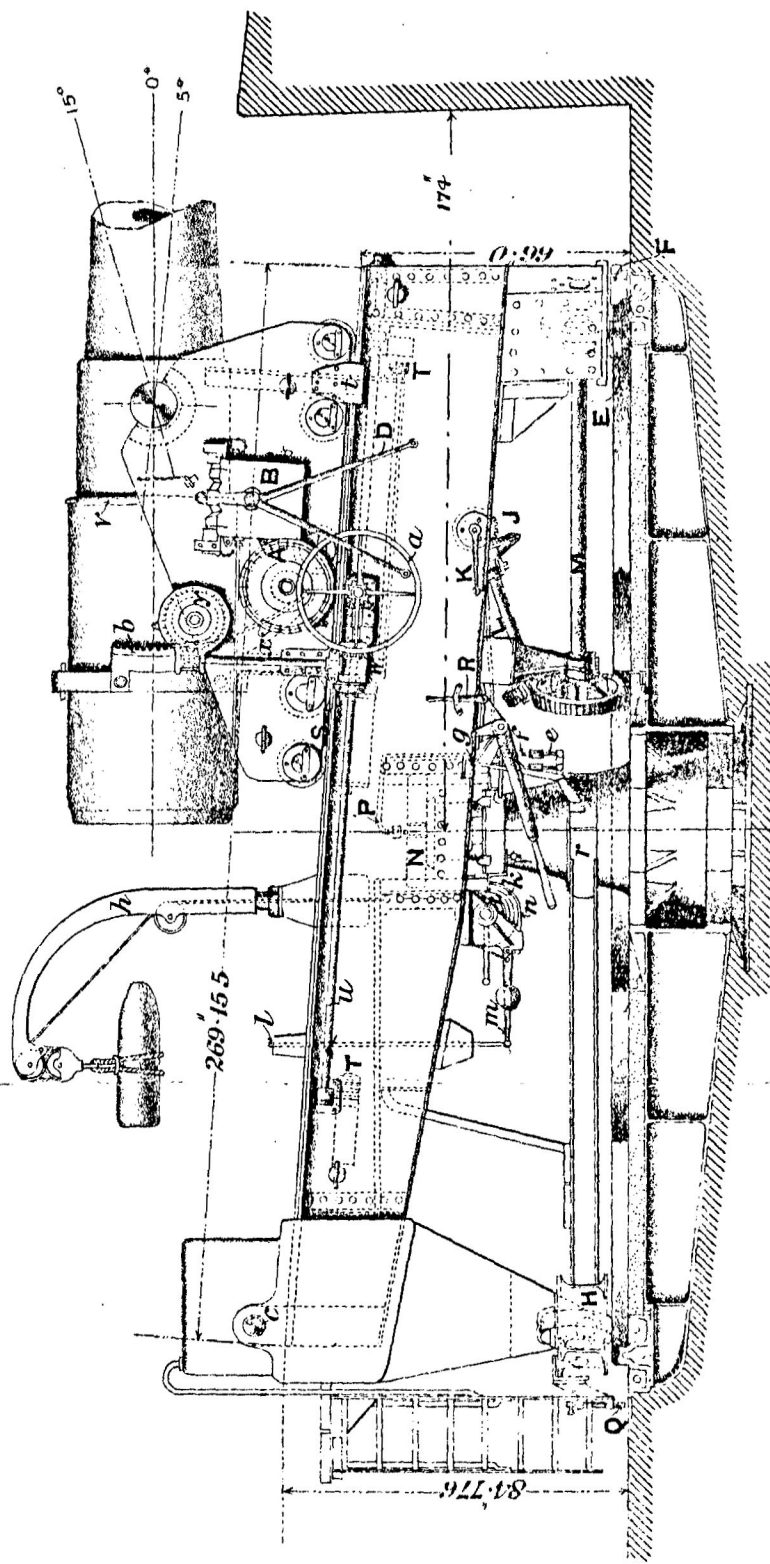


— CARRIAGE, GARRISON, BARBETTE, B. L. 10 INCH, MARK III. —

— (STEEL.) —

— SLIDE, L. BARBETTE, B. L. 10 INCH, MARK III. —

— (STEEL.) —

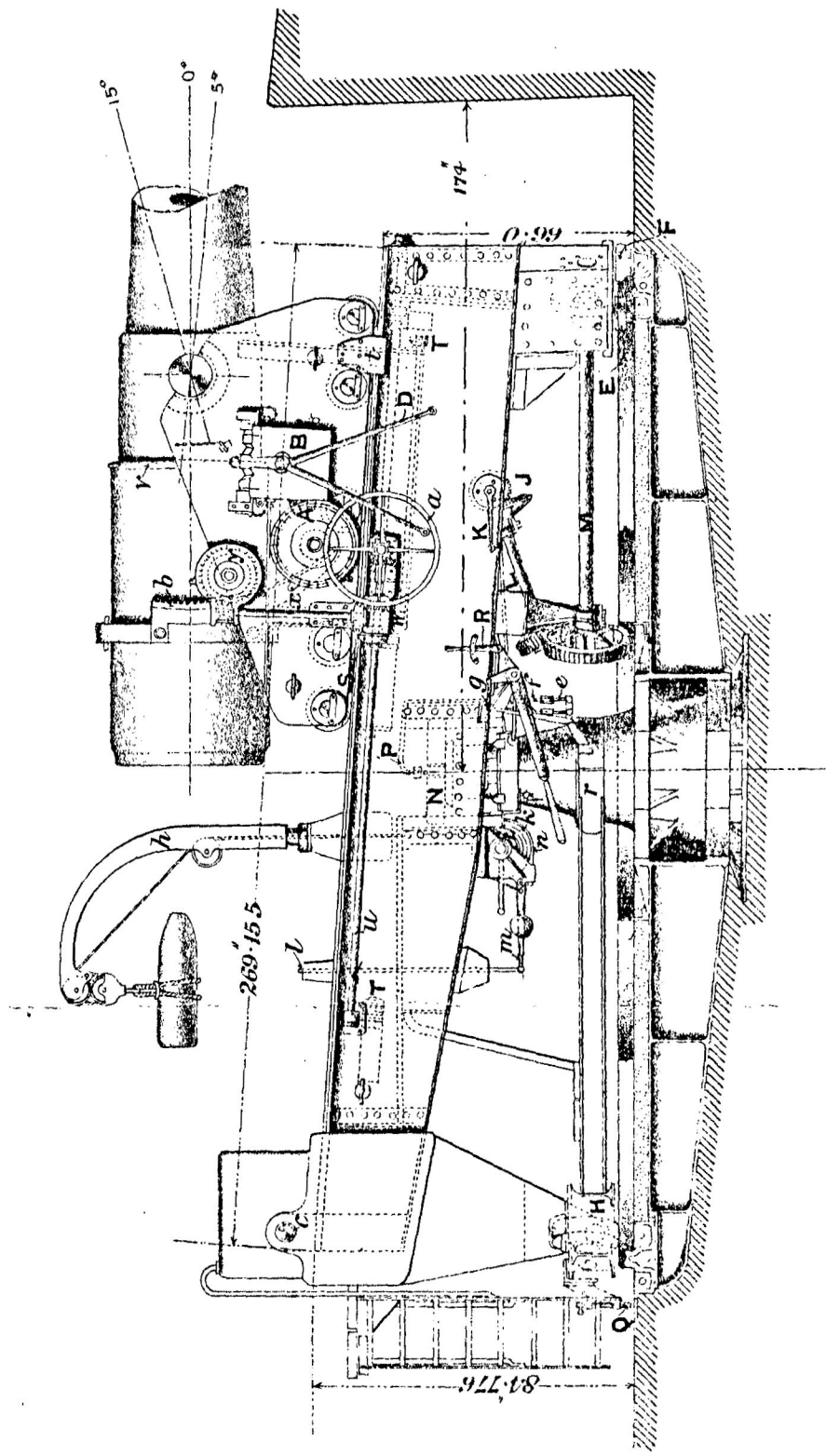


— SIDE ELEVATION. —

— (STEEL.) —

— SLIDE, L. BARBETTE, B. L. 10 INCH, MARK III. —

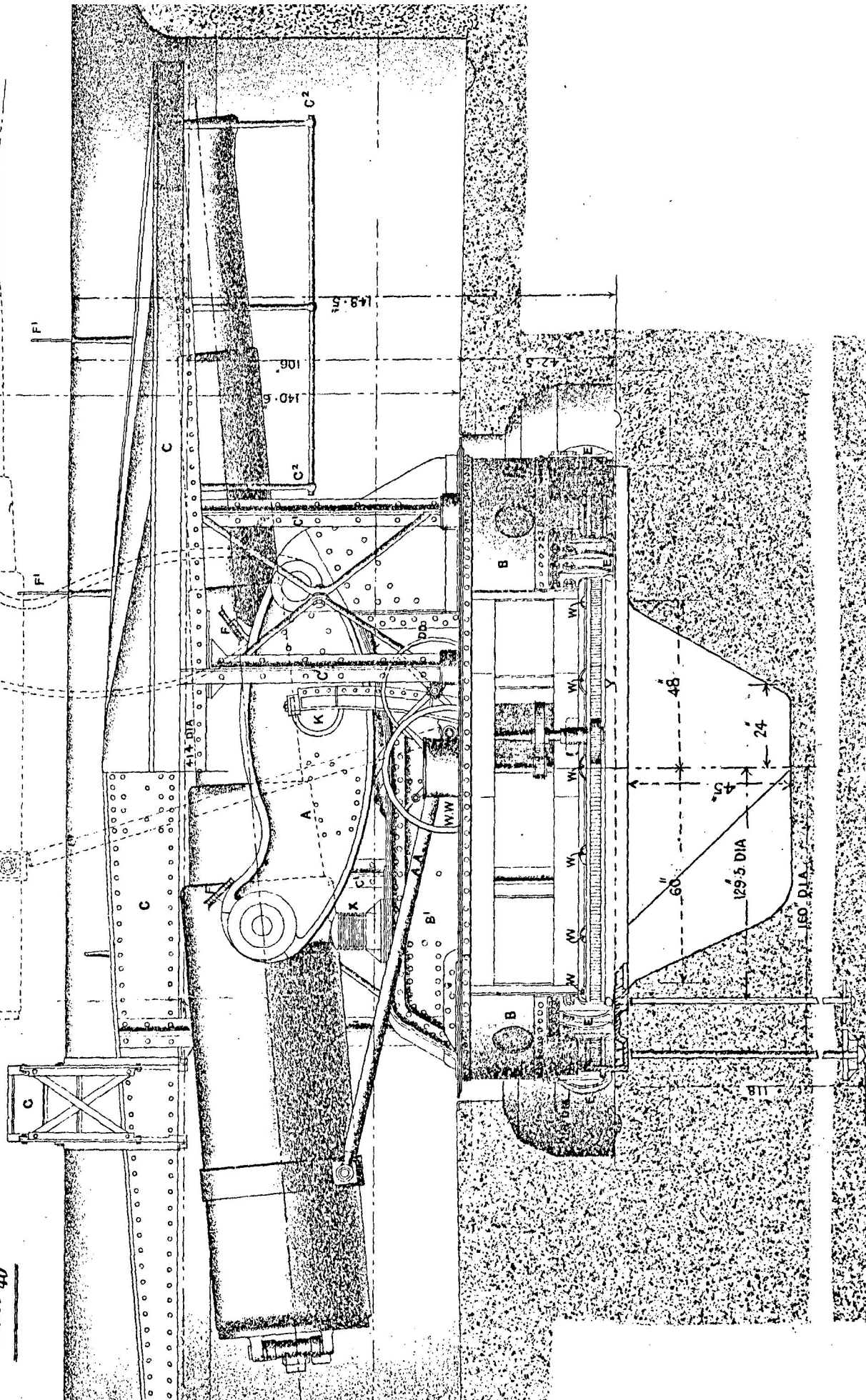
— (STEEL.) —



— SIDE ELEVATION. —

JARRISON, DISAPPEARING B. L.
 12 INCH MARK I. STEEL.
 WITH GUN IN LOADING POSITION.

Scale $\frac{1}{40}$



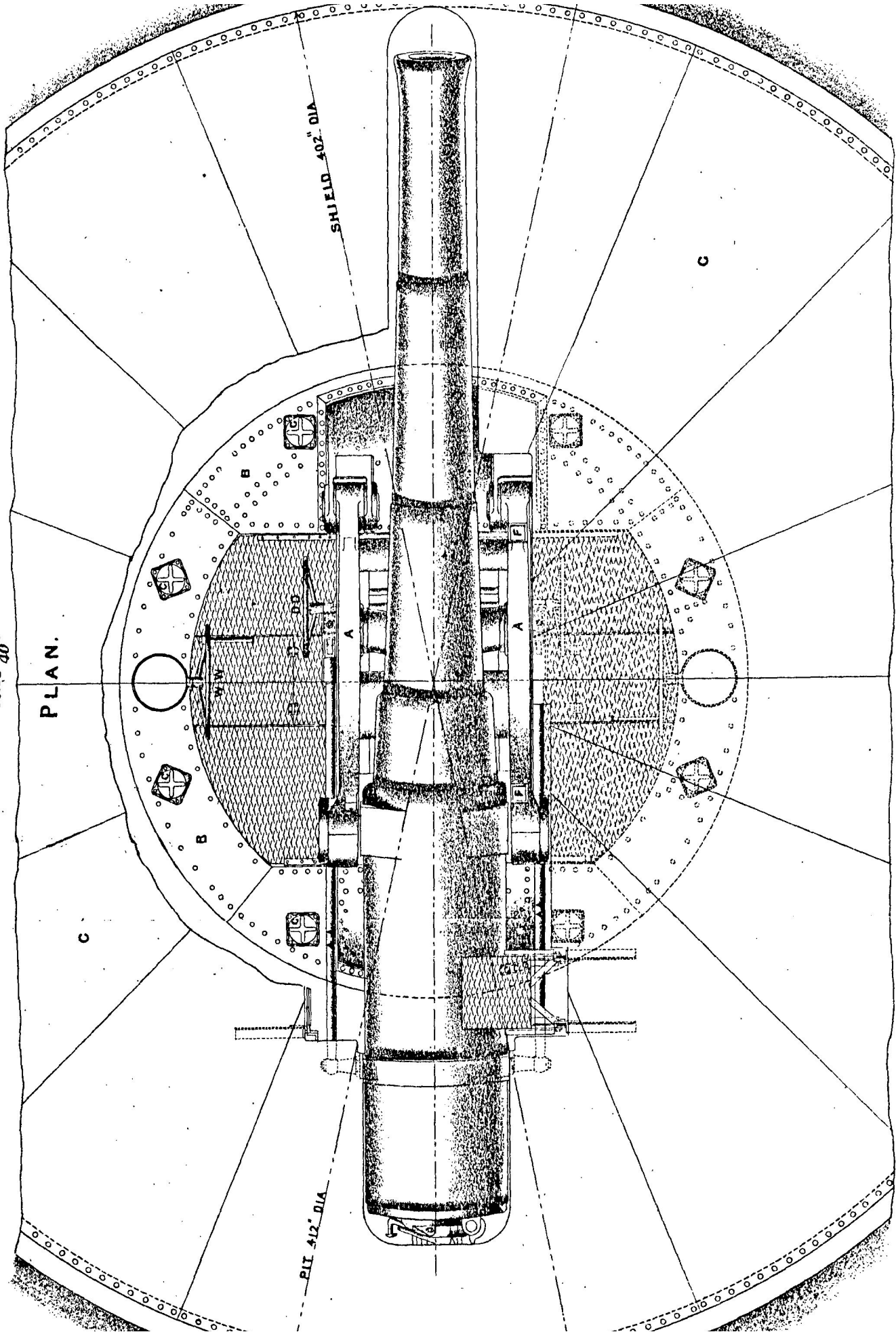
Scale $\frac{1}{40}$.

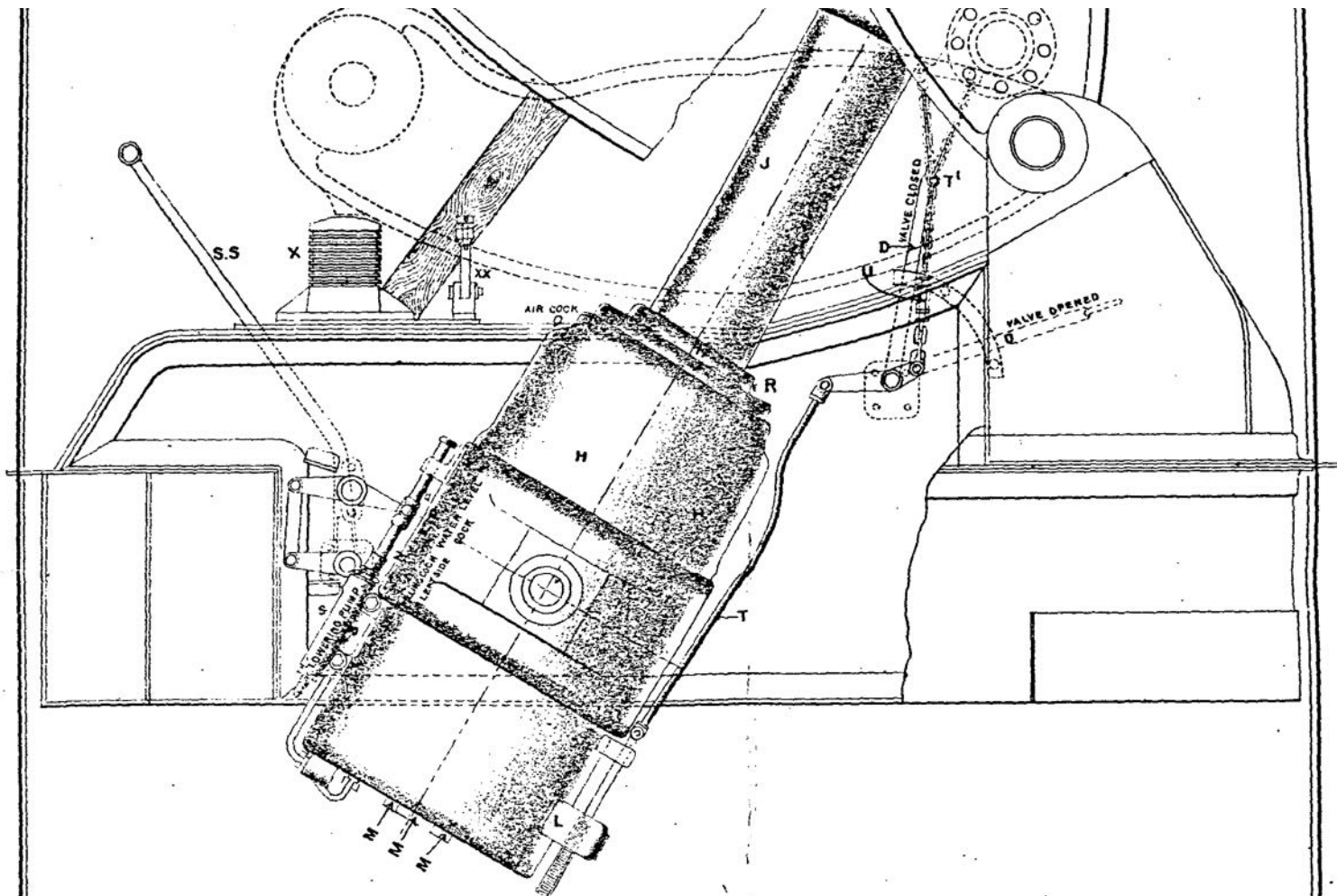
PLAN.

PII 412" DIA

SHIELD 402" DIA

Judd & Co Lith. 75 & 73, Cambridge St & Boston





CARRIAGE, GARRISON, DISAPPEARING, B.L. 10 INCH. MARK I.

ARRANGEMENT OF CUT OFF GEAR.

Scale $\frac{1}{24}$

ARRANGEMENT OF ELEVATING GEAR.

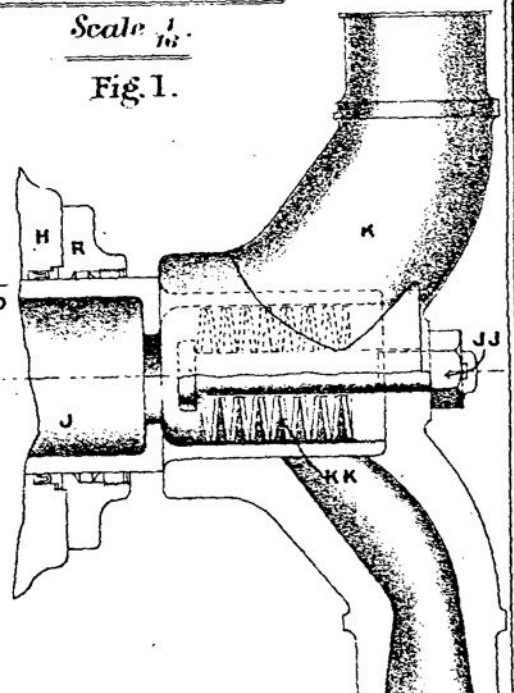
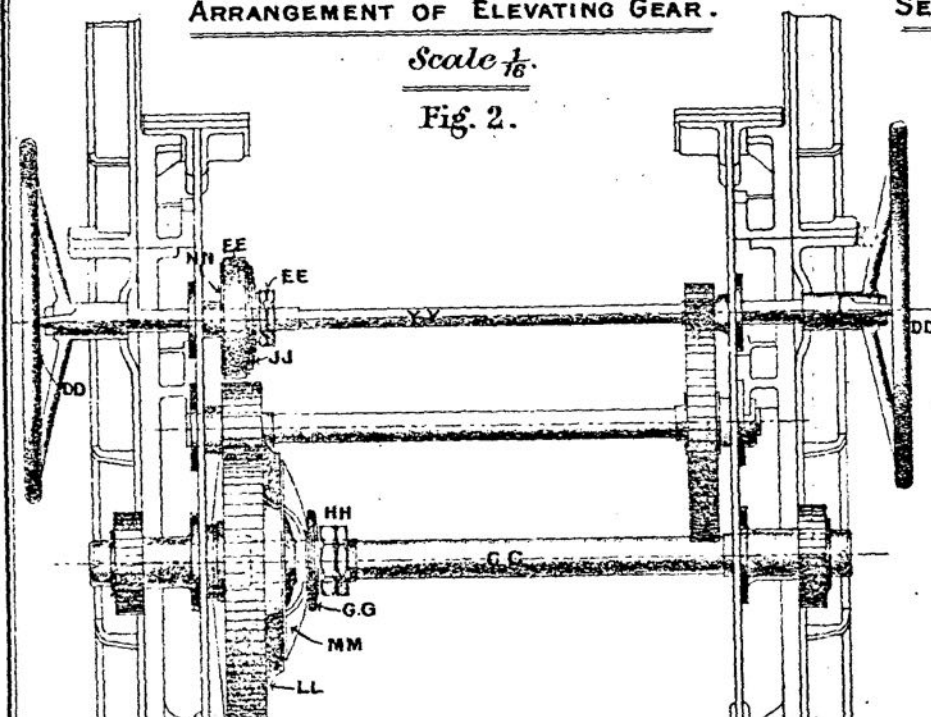
Scale $\frac{1}{16}$.

Fig. 2.

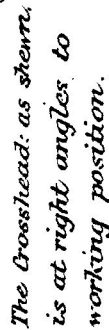
SECTION OF CROSSHEAD.

Scale $\frac{1}{16}$.

Fig. 1.

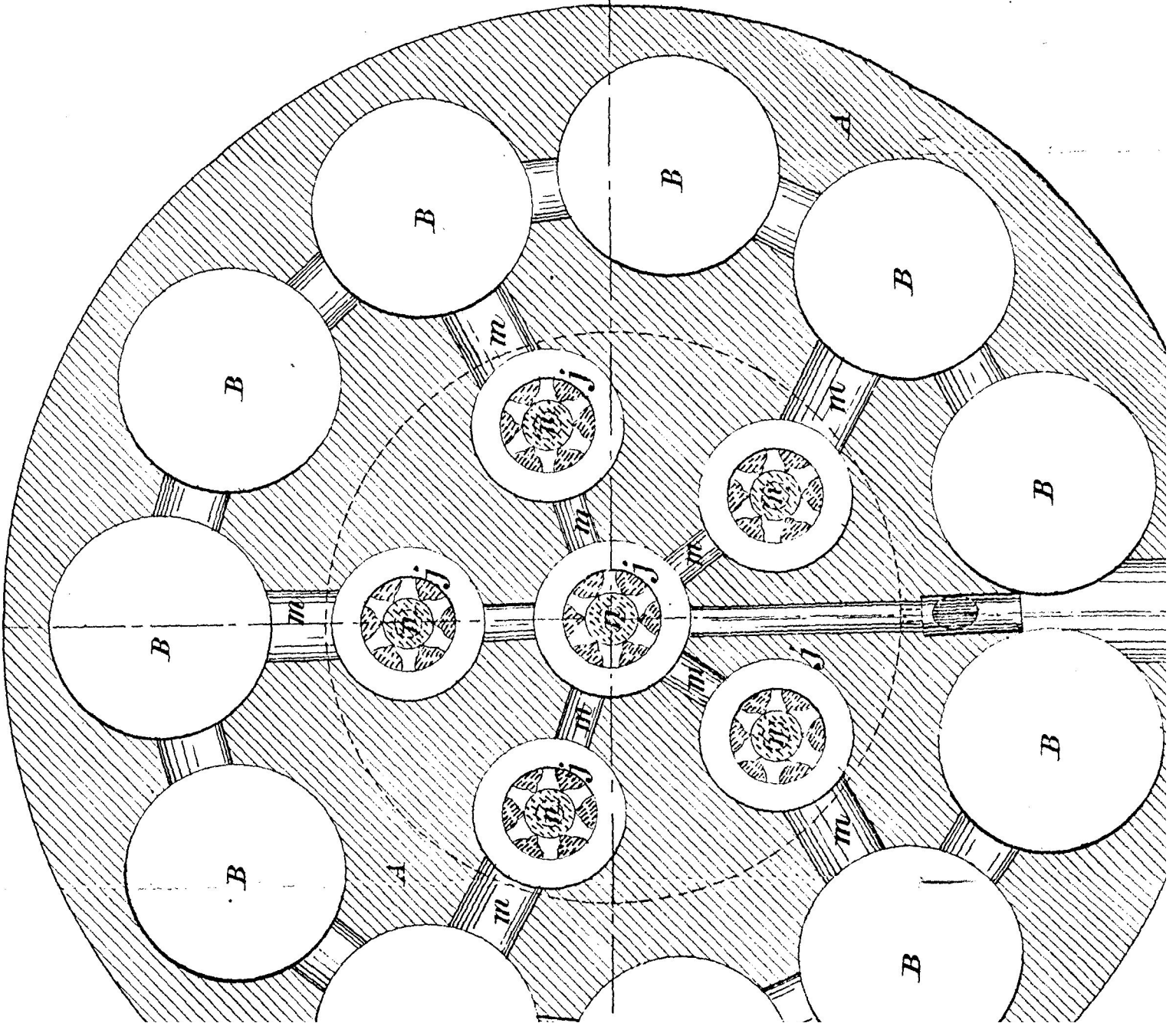
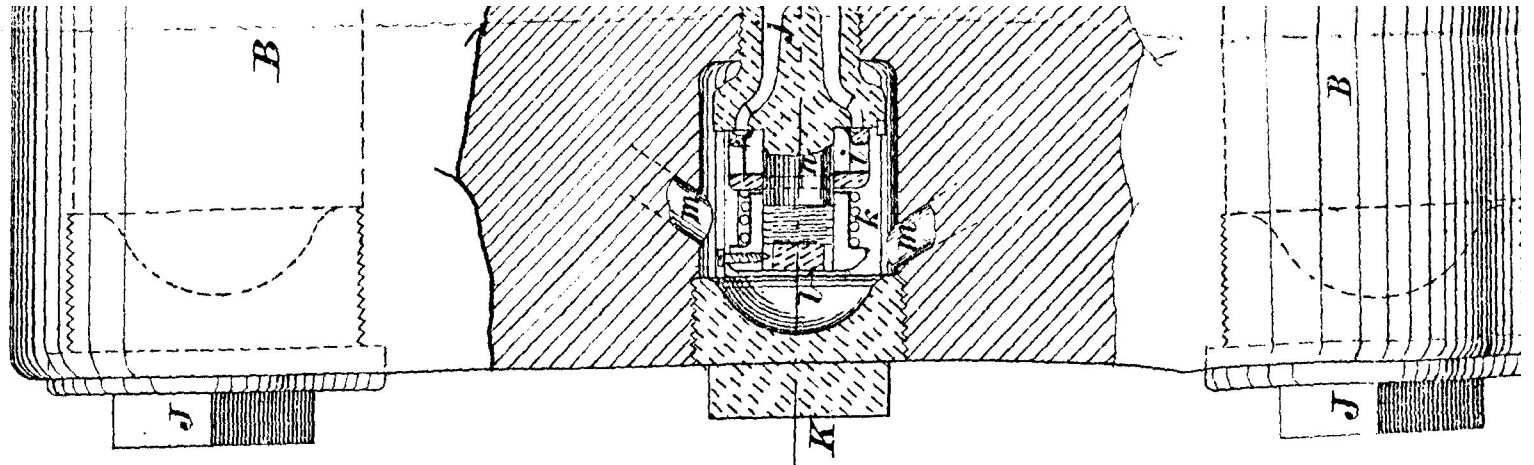


RECOIL CYLINDER.—



- L. Valve, water level.
M. do filling.
N. Gland, outer.
O. Ring, packing gland, outer.
P. Box stuffing, cylinder, recoil.
Q. Cover, cylinder recoil.
R. Stands, cover do do.
S. Leather, packing.
T. Ring packing, leather.
U. Pump, lowering.

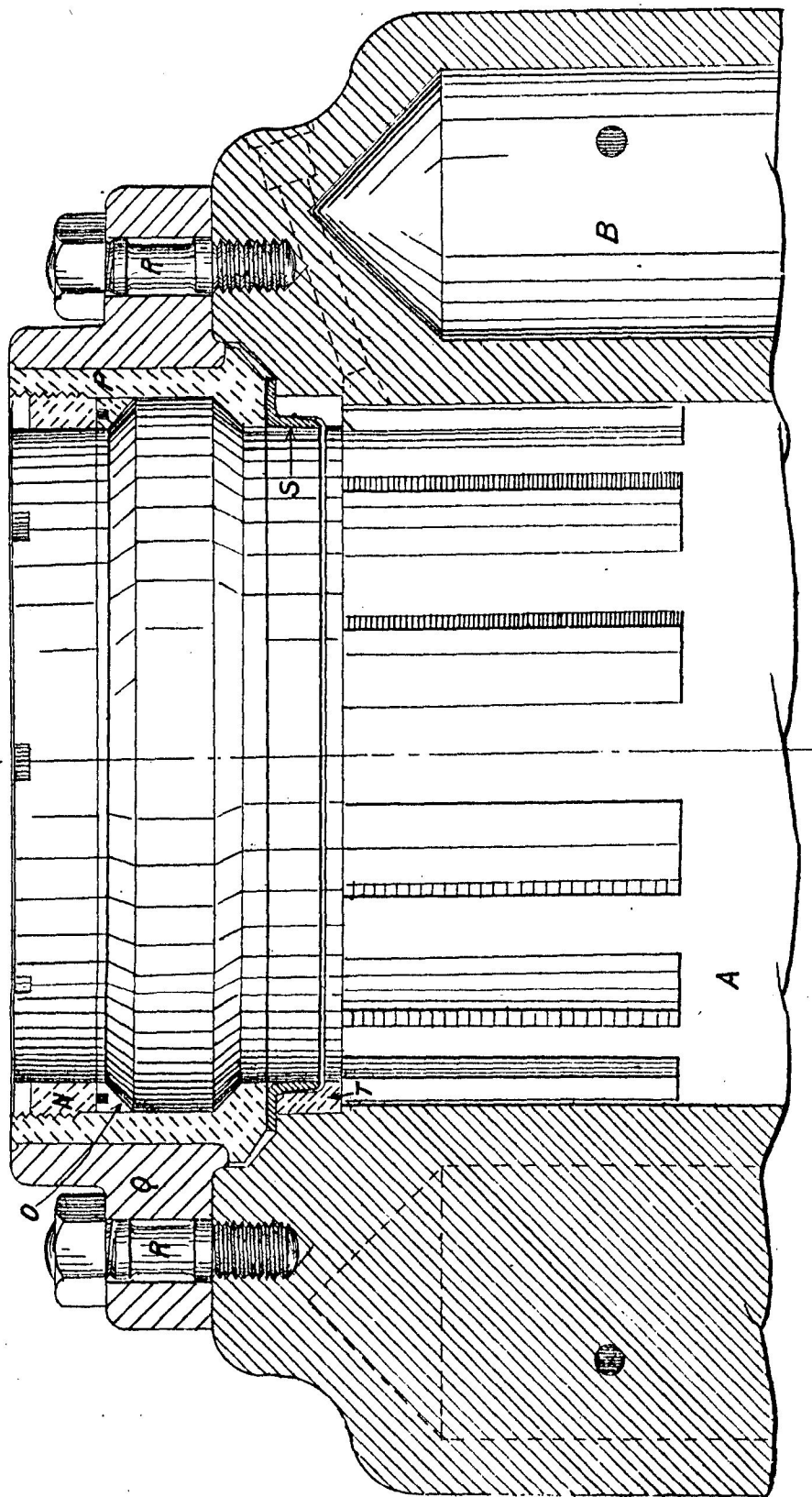
- Cylinder, Recoil.
Air chamber.
Crosshead.
Ram.
Band union.
Sole crosshead.
Springs, ram.
Plug, ram. top.



CARRIAGE, GARRISON DISAPPEARING, B. L. 10 INCH M. K. I.

(HYDRO-PNEUMATIC.)

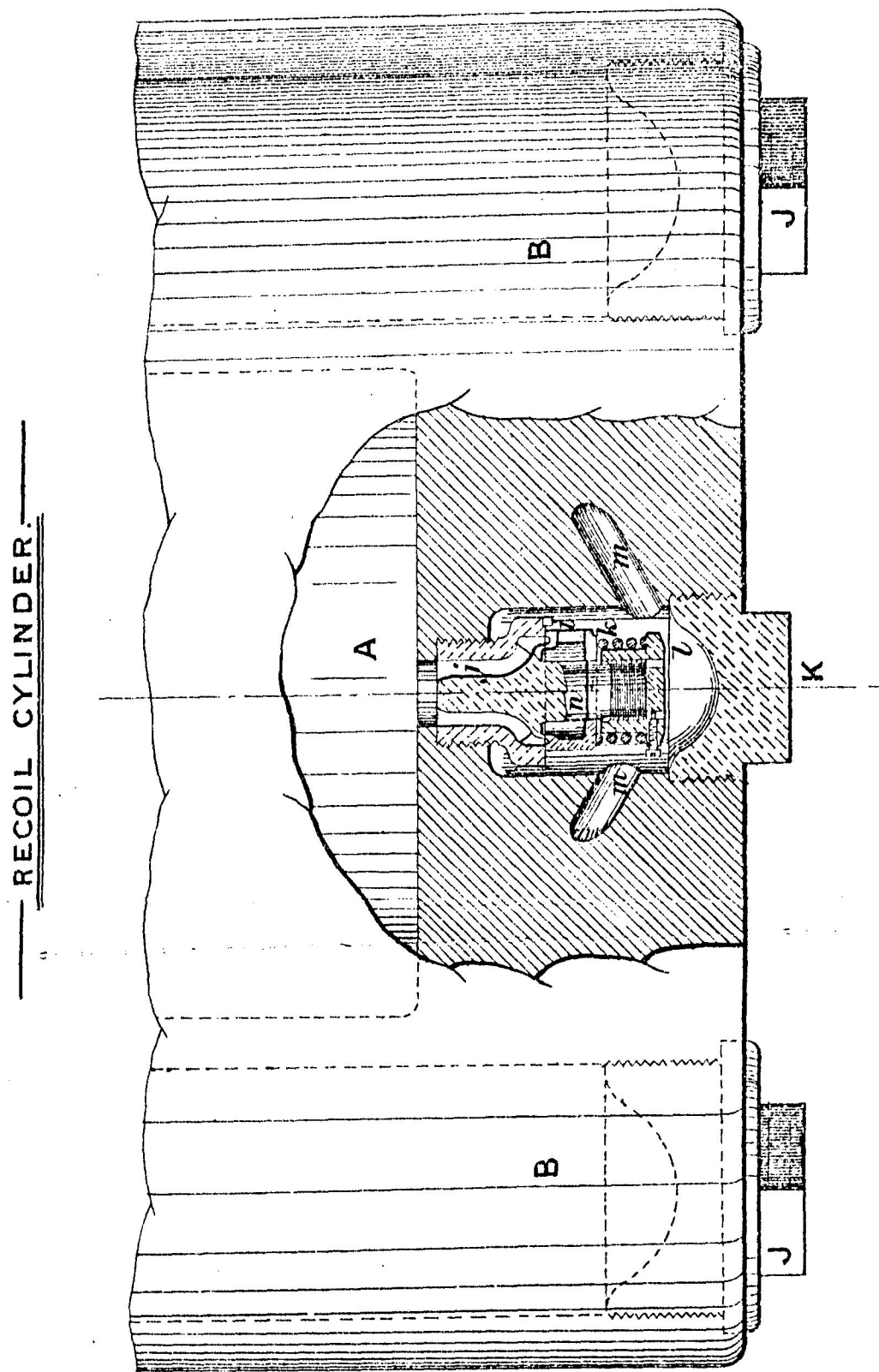
RECOIL CYLINDER.



A. Cylinder, recoil.
B. Air Chamber.
N. Gland.

O. Ring, packing gland.
P. Box, stuffing cylinder, recoil.
Q. Cover, cylinder recoil.

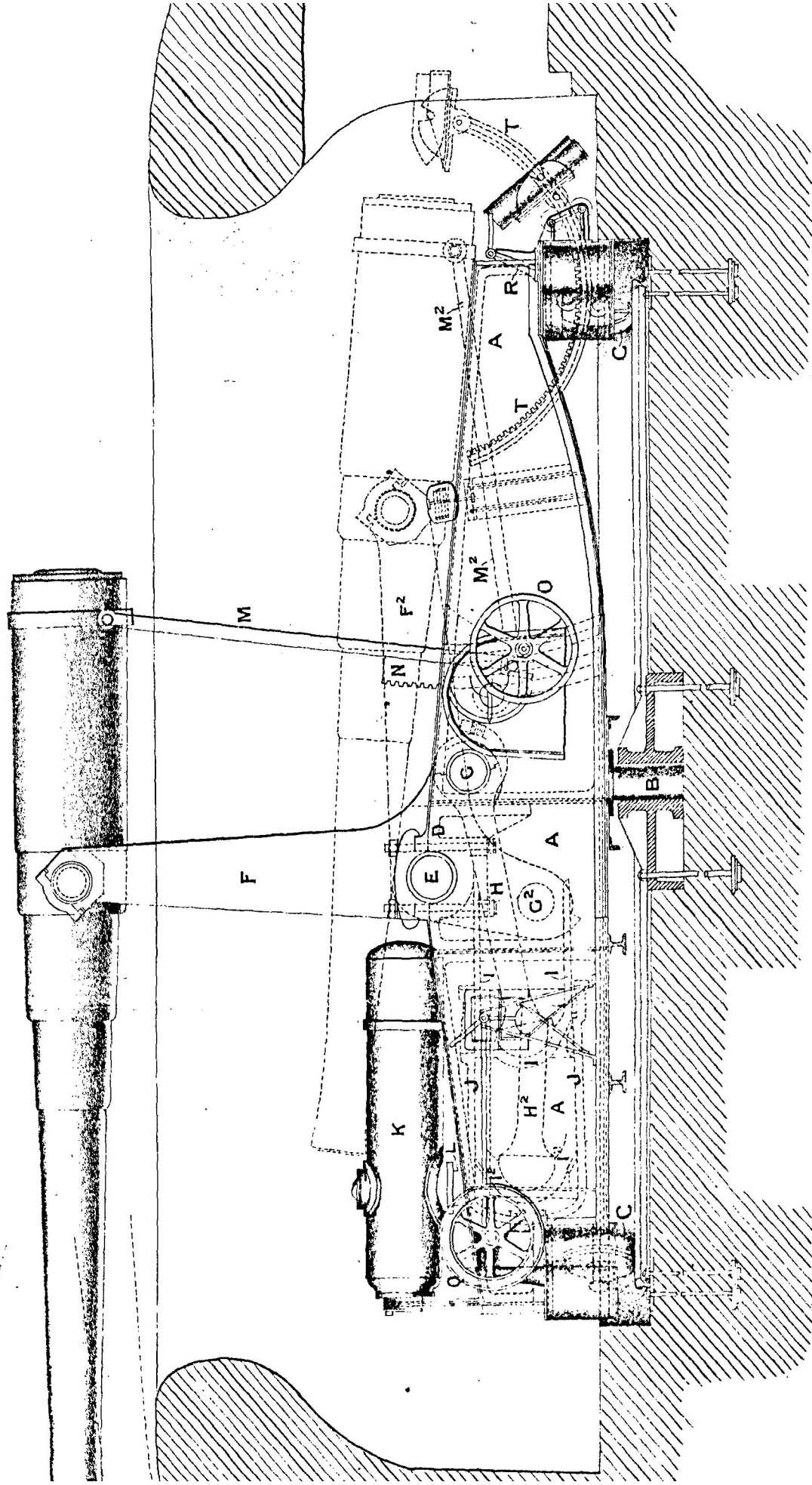
R. Studs, cover, cylinder recoil.
S. Leather, packing.
T. Ring, packing leather.



- A Grinder, *Recoil.*
 B Air chamber.
 J Plug, air chamber.
 K Cover, valve recoil.
 i Valve, recoil.
 j Scrappings, valve recoil
 k Springs
 l Nut, adjusting, valve recoil
 m Passages to air chambers
 n Spindle, valve recoil.

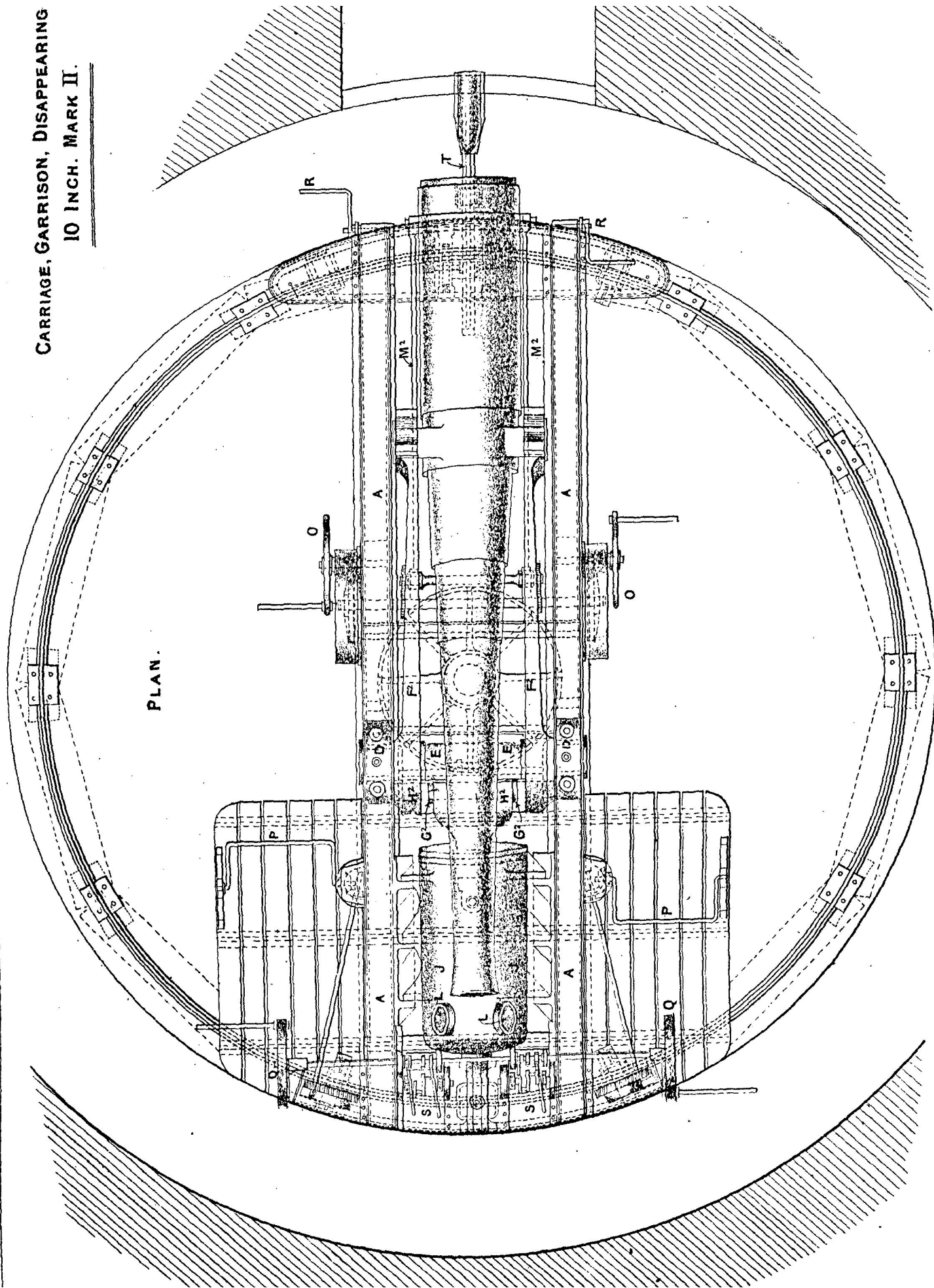
CARRIAGE GARRISON DISAPPEARING B. L. 10 INCH MARK II.

ELEVATION.



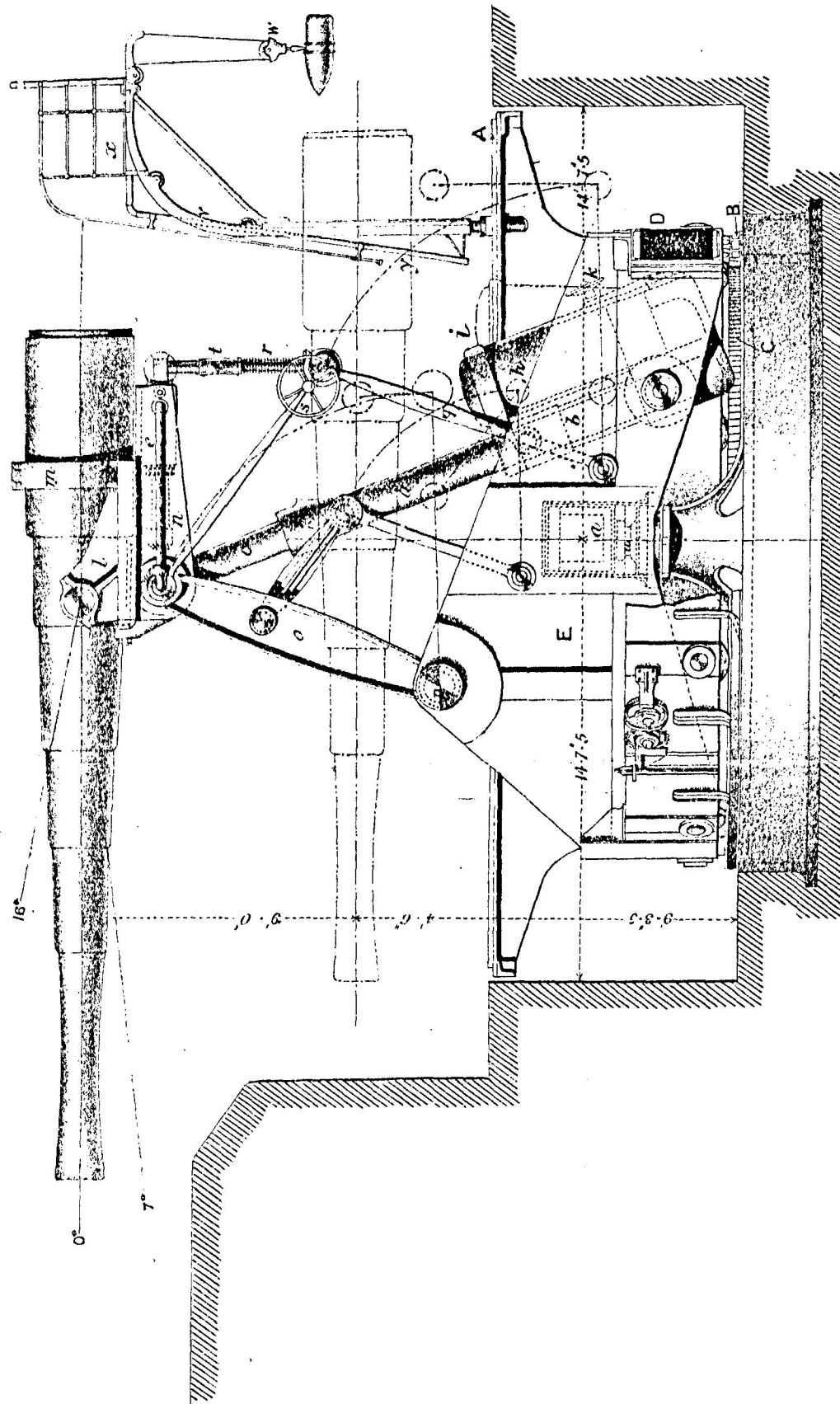
CARRIAGE, GARRISON, DISAPPEARING
10 INCH. MARK II.

PLAN.



CARRIAGE, GARRISON, DISAPPEARING B.L. 10 INCH MARK III.

— STEEL —



SIDE ELEVATION.

CARRIAGE, GARRISON. DISAPPEARING, B. L. 10 INCH. MARK I. HYDRO-PNEUMATIC.

Scale 3 Inches = 1 Foot.

RAISING VALVE.

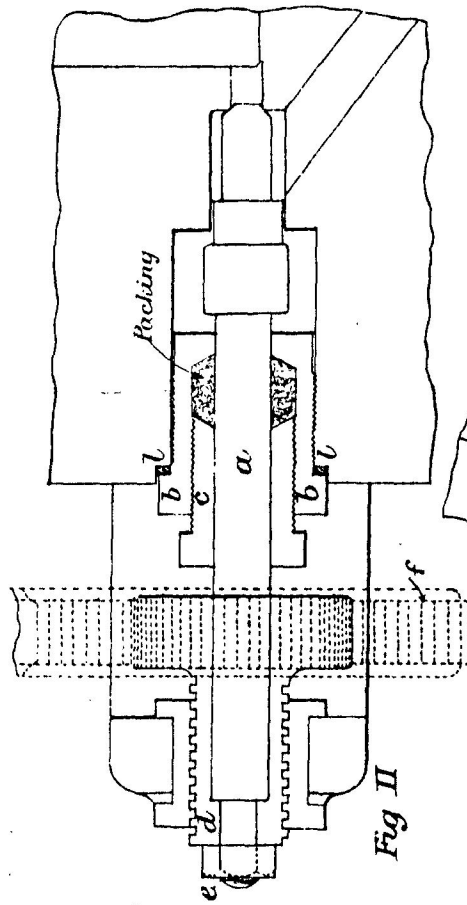


Fig II

RECOIL VALVE.

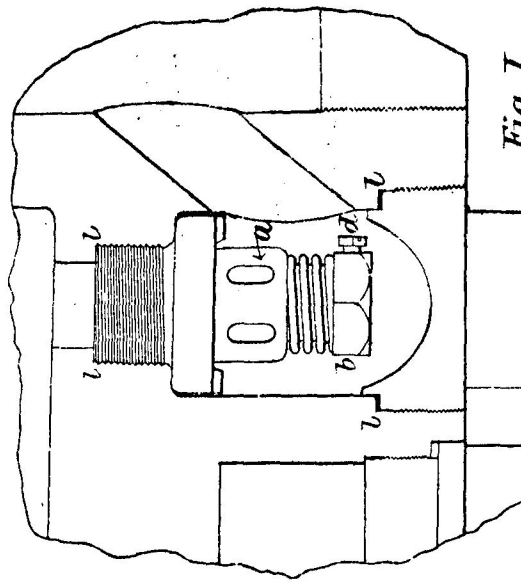
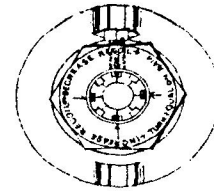
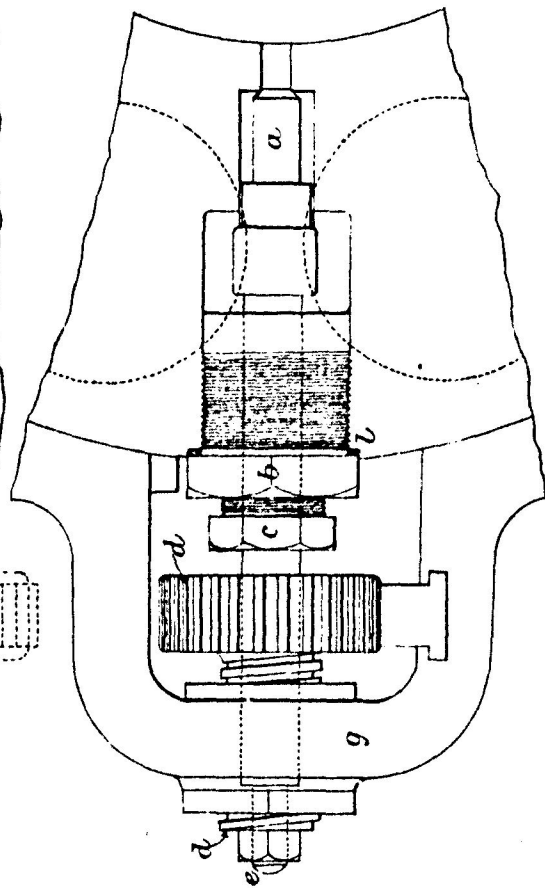
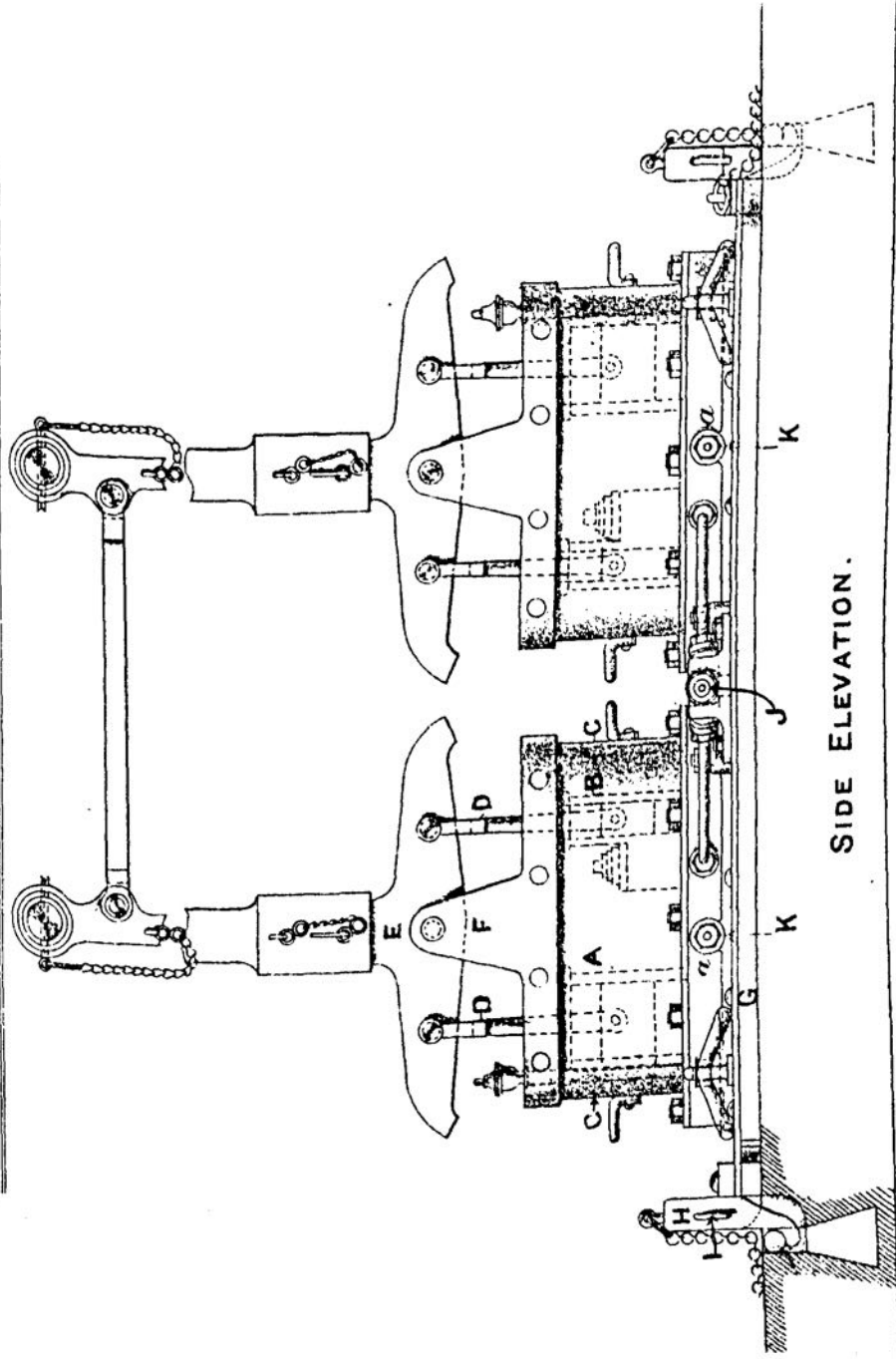


Fig I.



PLAN with "c" removed

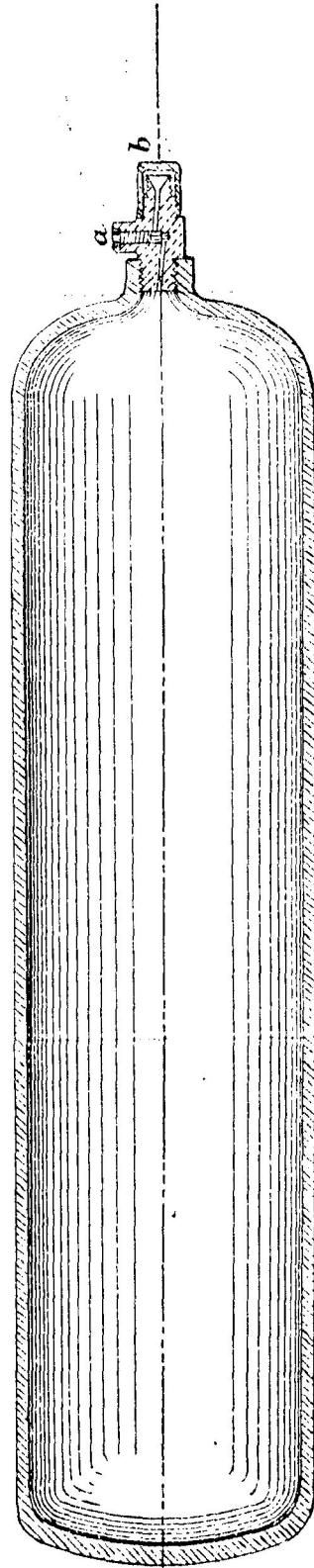
PUMP, AIR, DOUBLE, CARRIAGE, GARRISON, DISAPPEARING, MARK I.



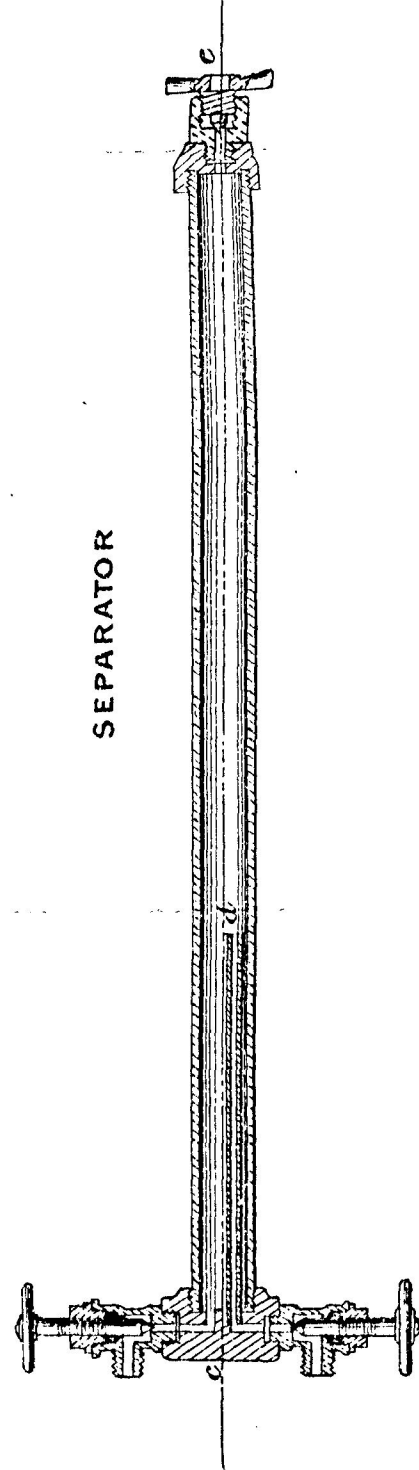
SIDE ELEVATION.

CARRIAGE GARRISON DISAPPEARING, B.L.

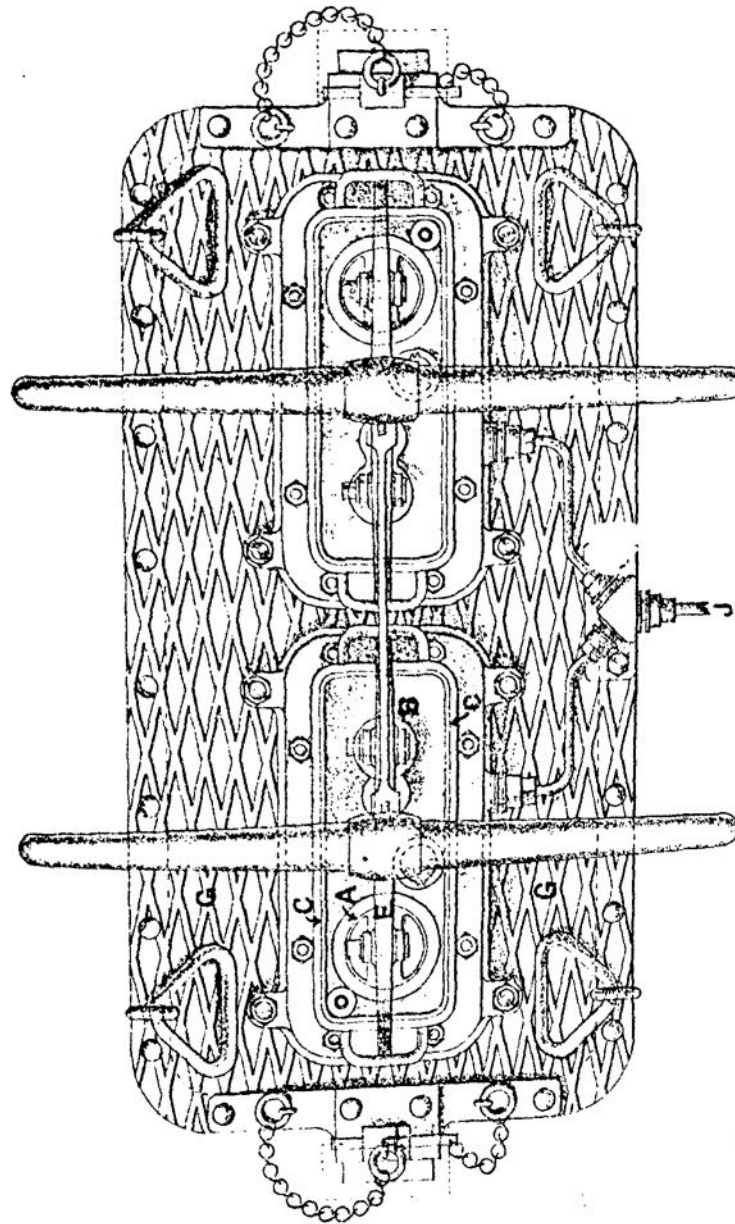
RESERVOIR FOR COMPRESSED AIR



SEPARATOR

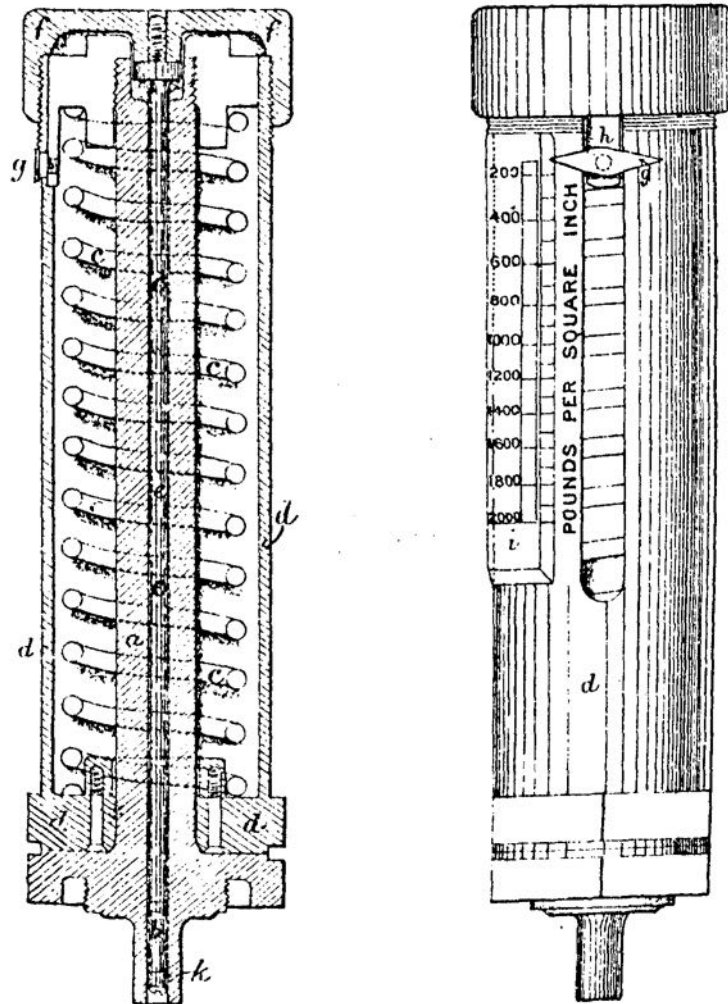


PUMP, AIR, DOUBLE, CARRIAGE, GARRISON, DISAPPEARING, MARK I

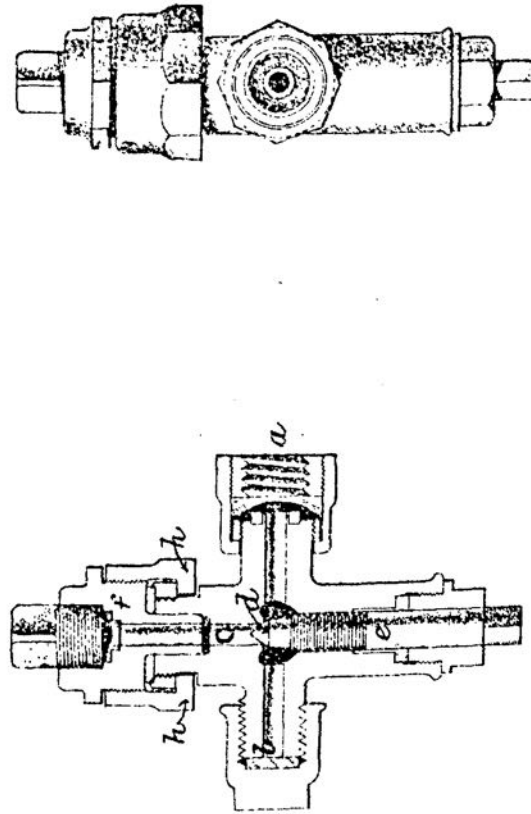


TOP PLAN

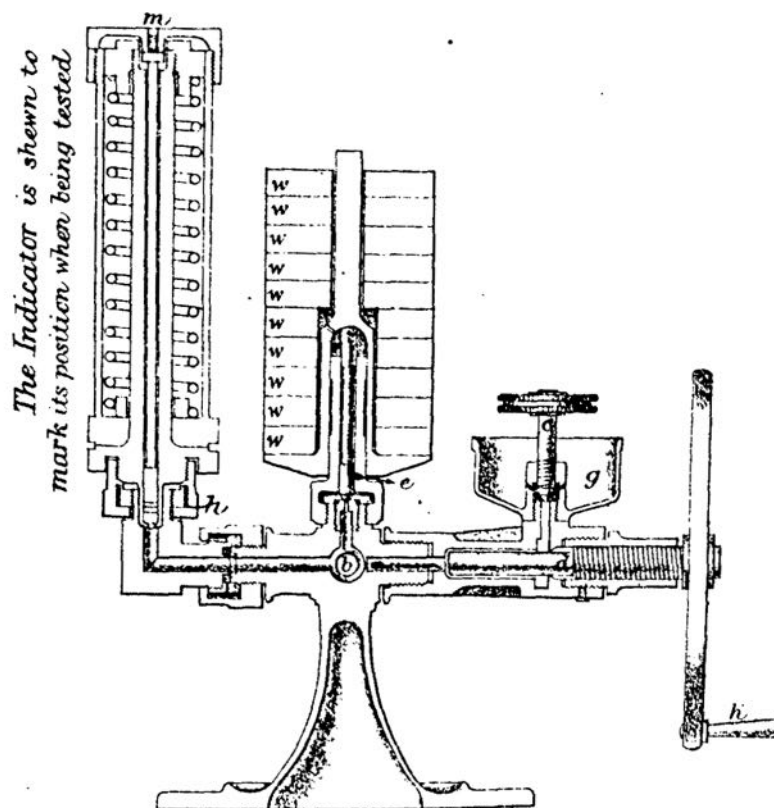
INDICATOR, PRESSURE SPRING, CARRIAGE,
GARRISON DISAPPEARING MARK I.



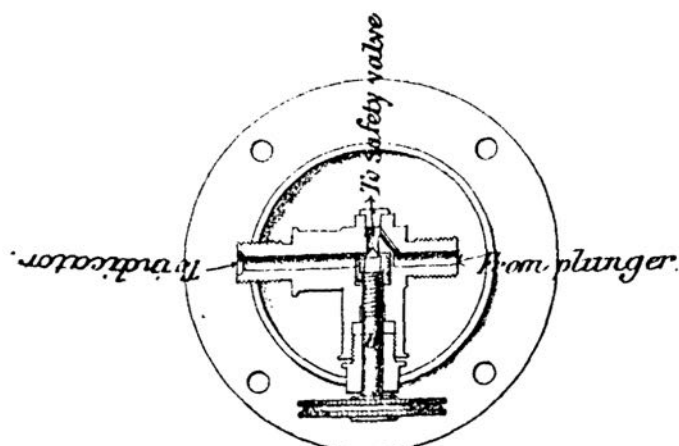
CONNECTION, INDICATOR, PRESSURE, CARRIAGE, GARRISON, DISAPPEARING.



GAUGE PRESSURE, DEAD WEIGHT, TESTING. MARK I.



SECTIONAL ELEVATION.

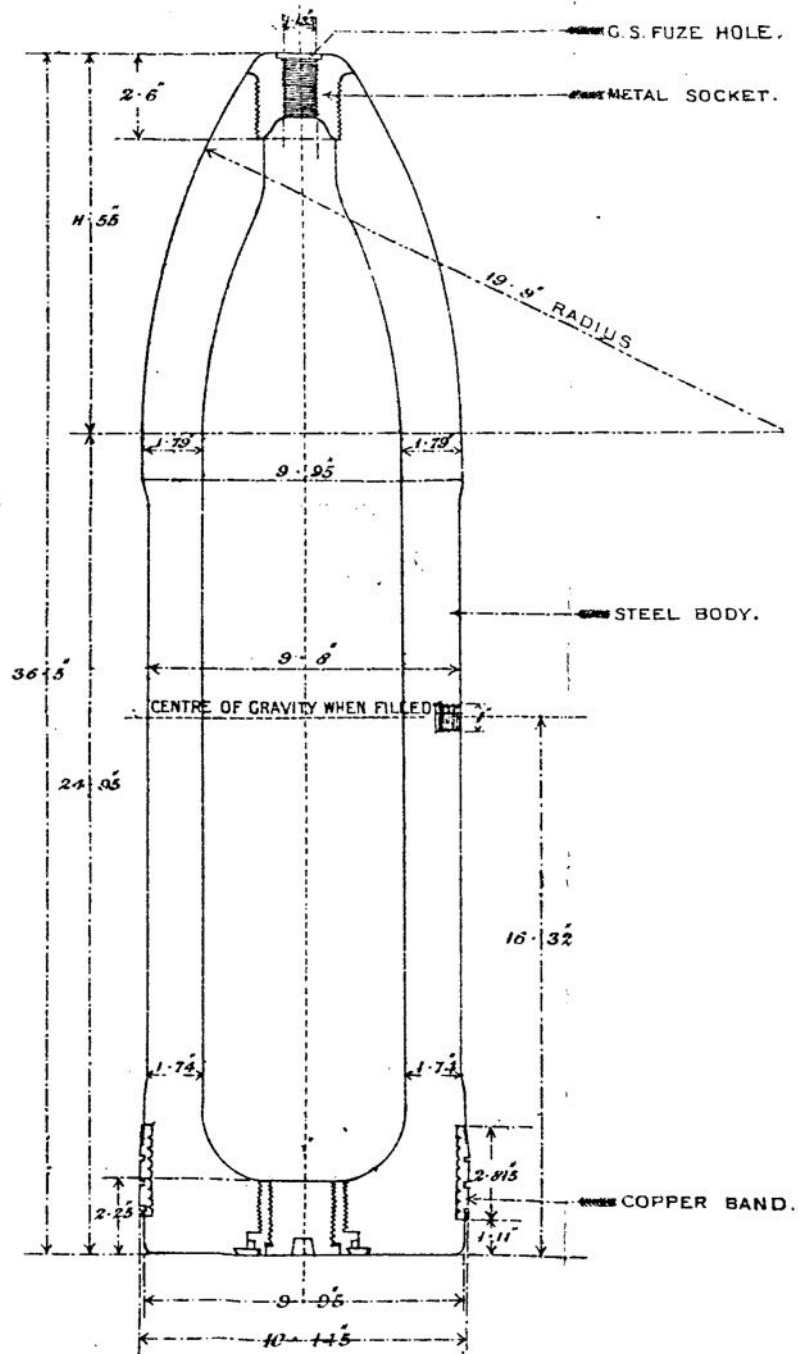


SECTIONAL PLAN.

SHELL B. L. COMMON 10 INCH CAST STEEL - MARK I.

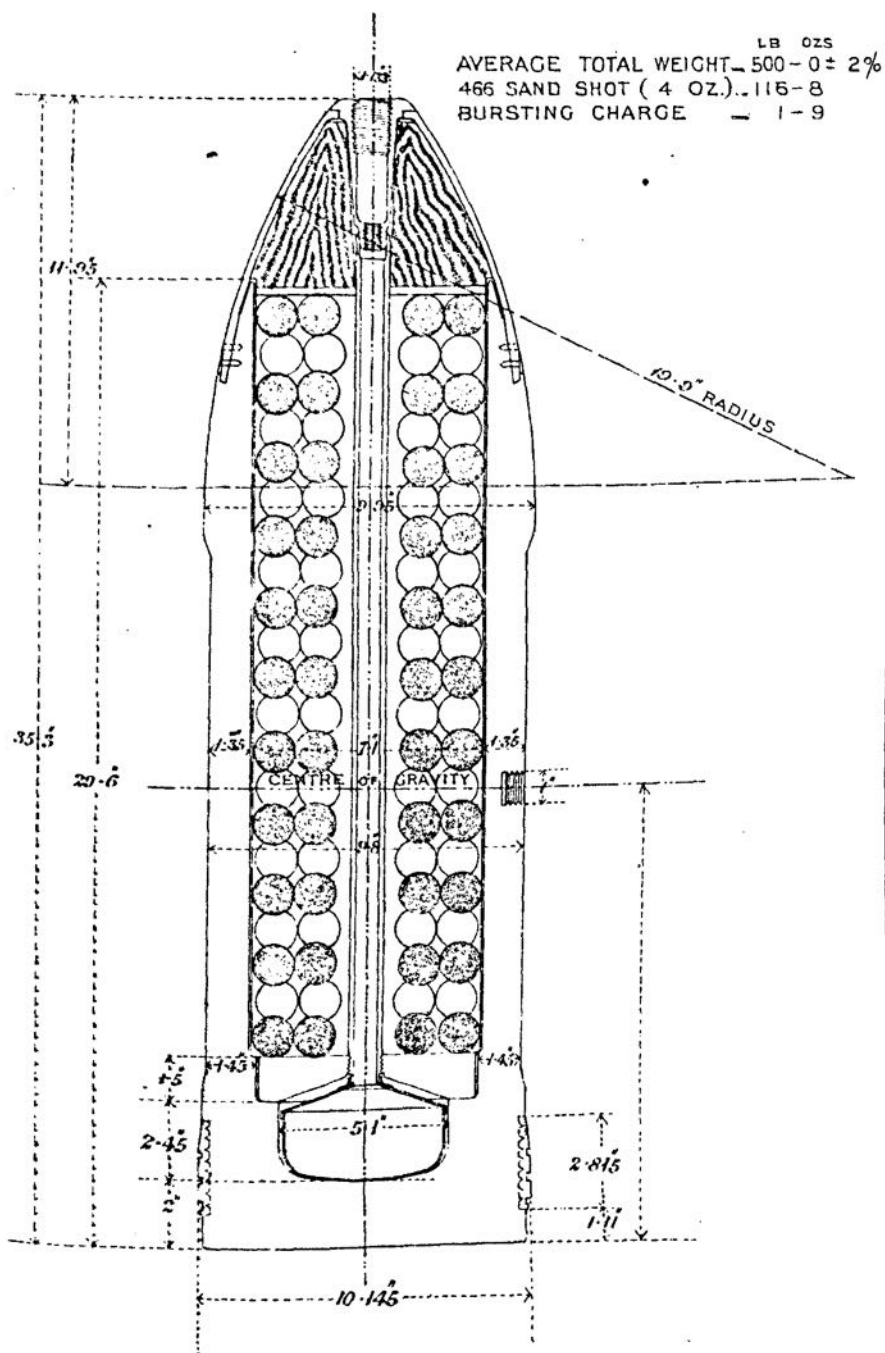
Scale $\frac{1}{6}$.

LB. 0.25
AVERAGE TOTAL WEIGHT \rightarrow 500.0
BURSTING CHARGE \rightarrow 37.12



SHELL B. L. SHRAPNEL 10-INCH CAST STEEL-MARK I.

SCALE $\frac{1}{6}$.

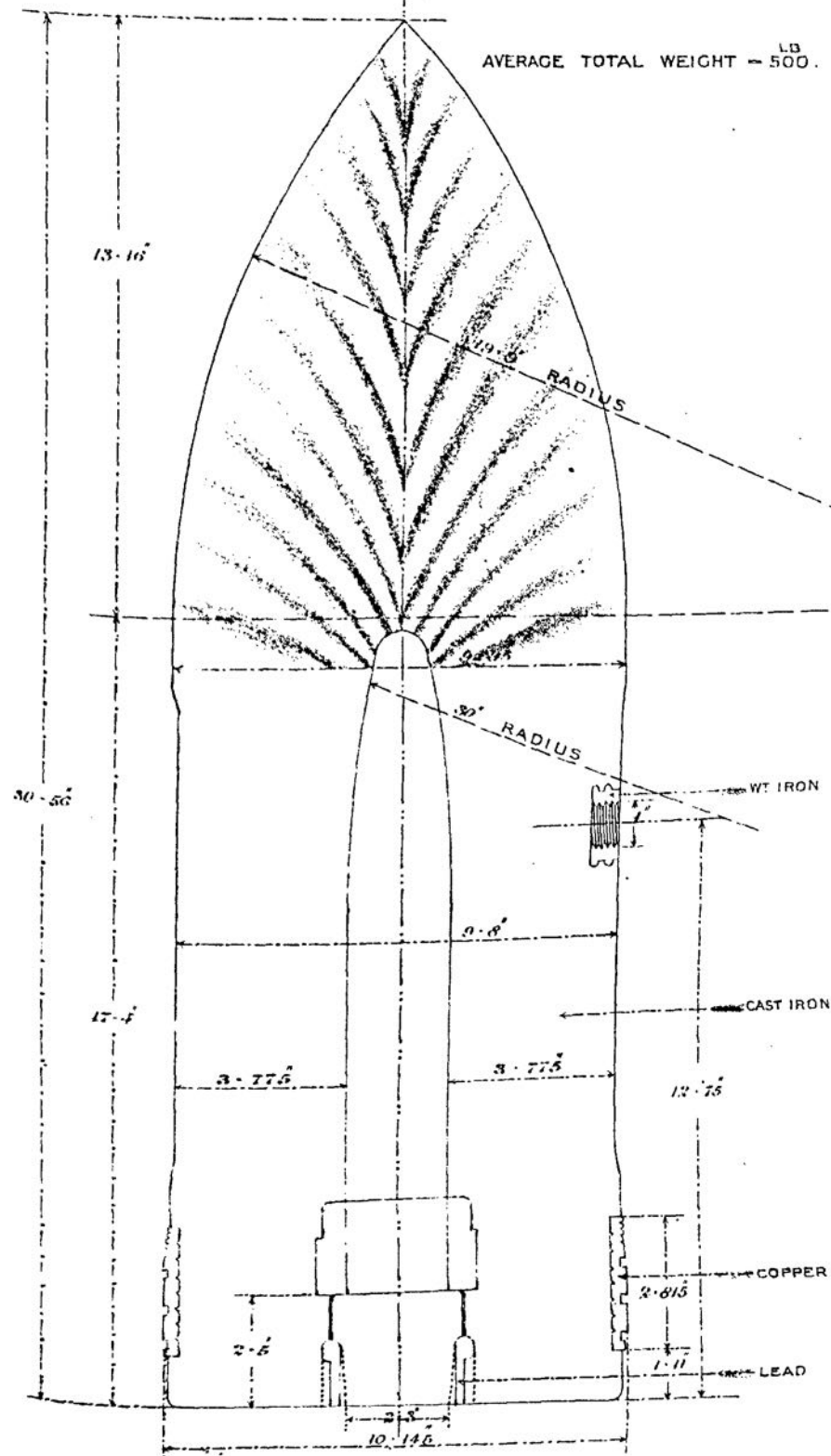


SUPERINTENDENT
ROYAL LABORATORY.

SHOT B. L. PALLISER 10 INCH MARK I.

Scale $\frac{1}{4}$.

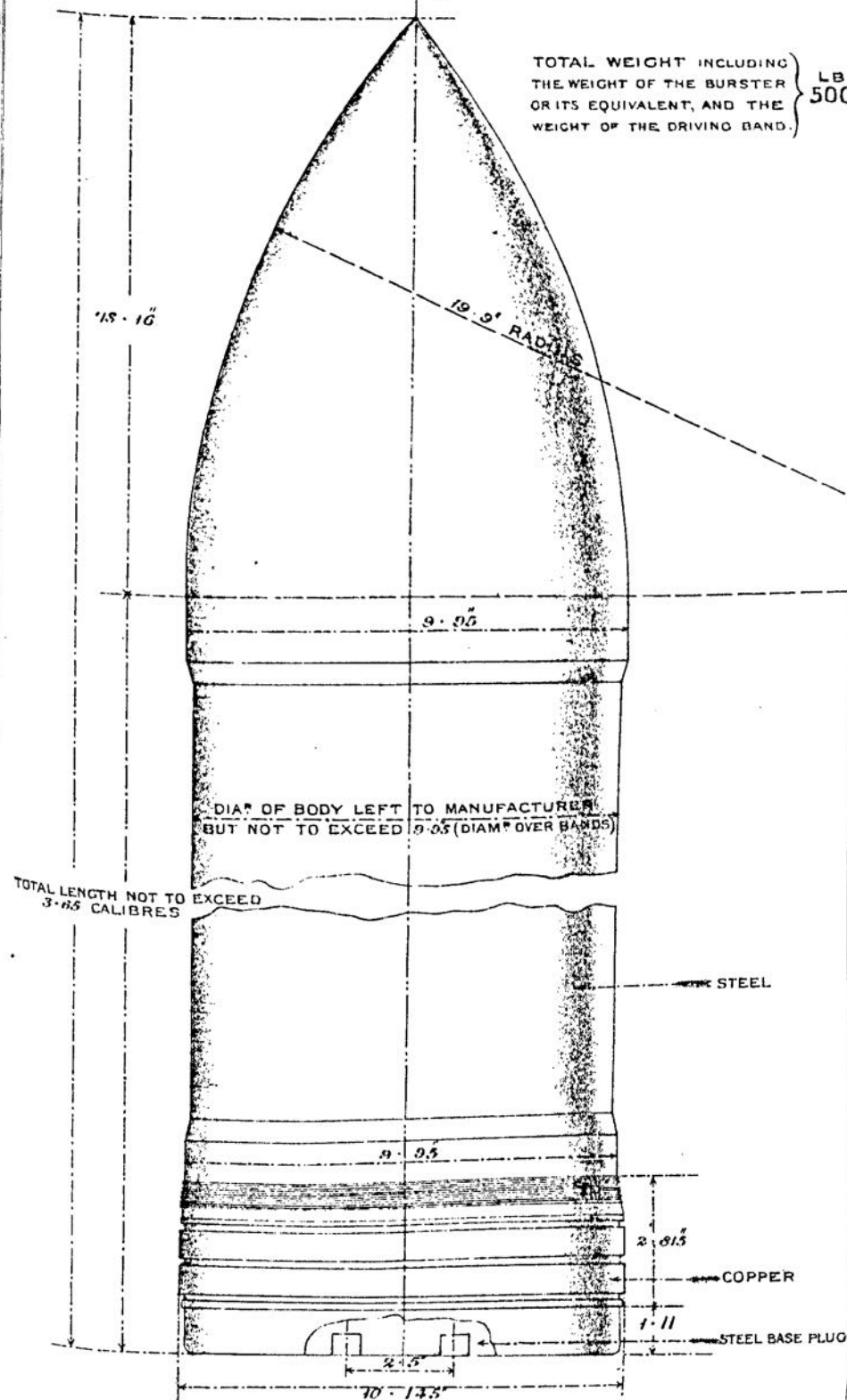
AVERAGE TOTAL WEIGHT = 500^{LB}.



SHOT B.L. ARMOUR PIERCING 10-INCH FORGED STEEL-MARK I.

Scale $\frac{1}{4}$ " = 1"

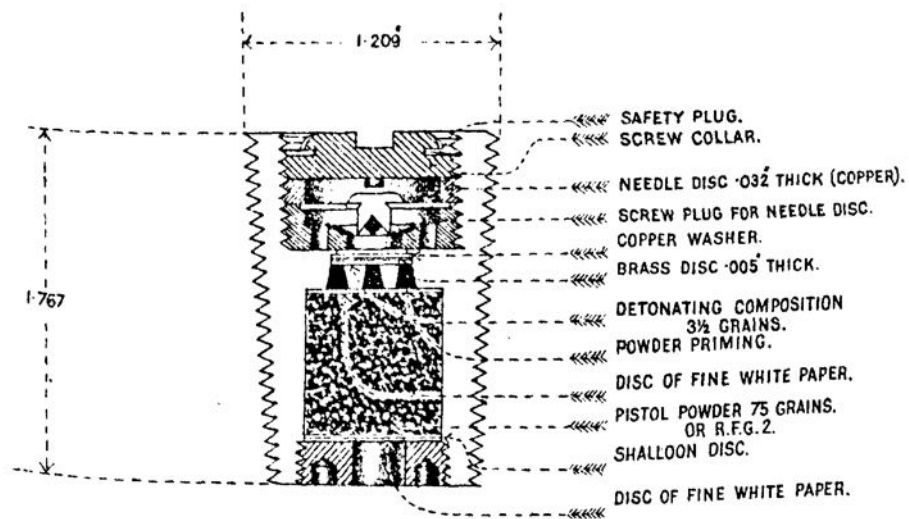
TOTAL WEIGHT INCLUDING
THE WEIGHT OF THE BURSTER
OR ITS EQUIVALENT, AND THE
WEIGHT OF THE DRIVING BAND. } LB
500



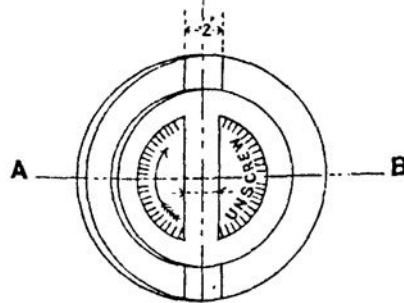
FUZE, PERCUSSION, DIRECT ACTION N°3. MARK III.

METAL 5 IN A TIN CYLINDER.

FULL SIZE.



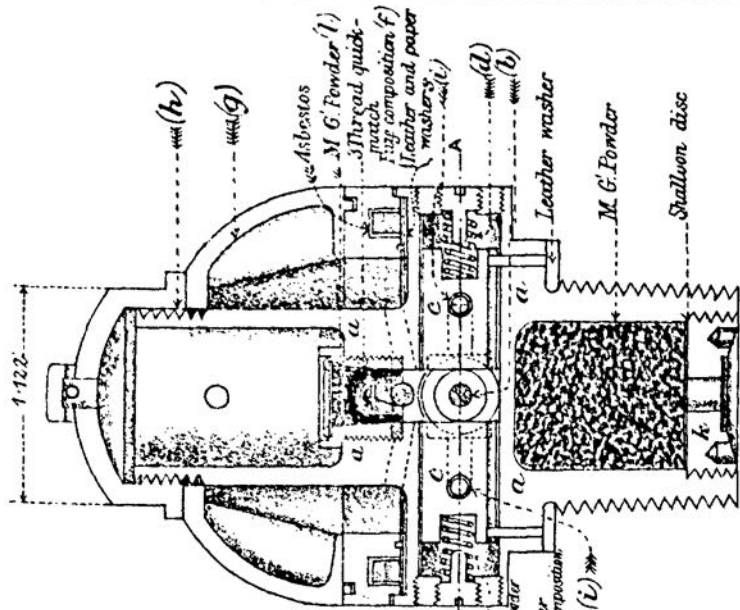
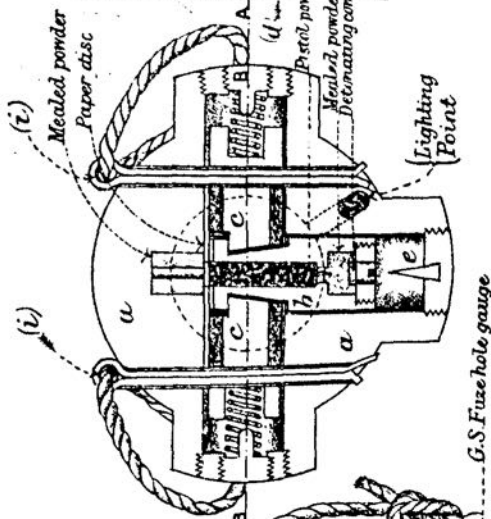
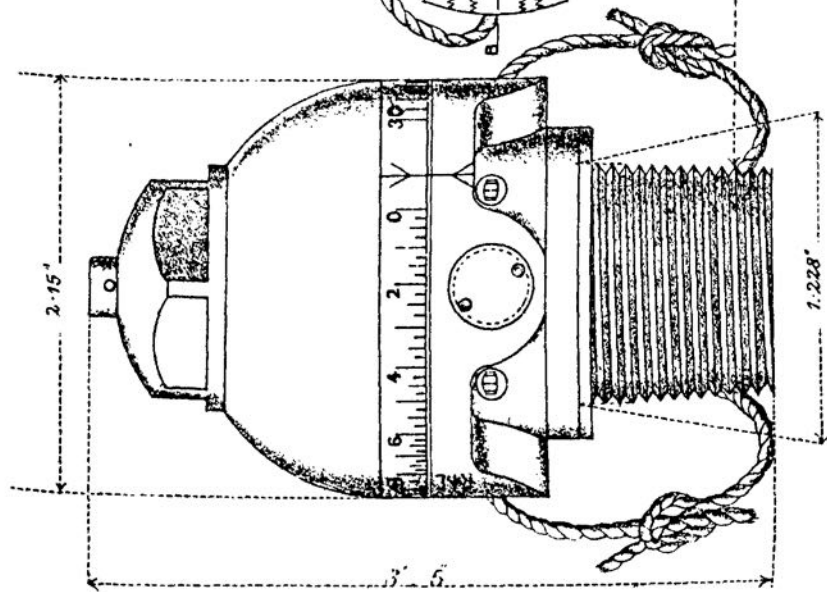
SECTION AT A.B.



PLAN.

FUZE TIME, SENSITIVE MIDDLE. NO 24. MARK I.

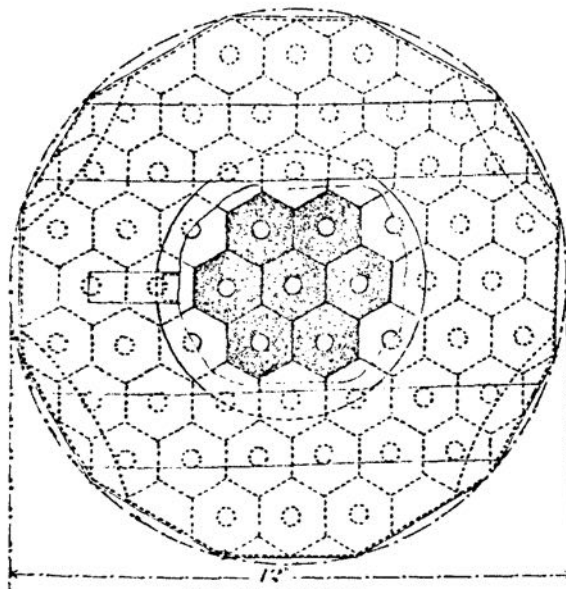
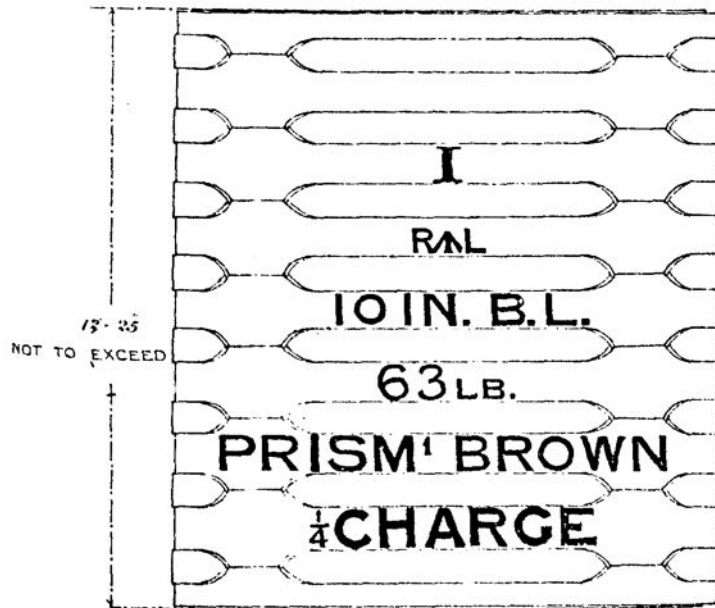
SCALE $\frac{1}{4}$
WEIGHT 1 LB. 4 OZ.



CARTRIDGE B. L. 10 INCH. 63 LB. PRISM¹ BROWN-MARK I.

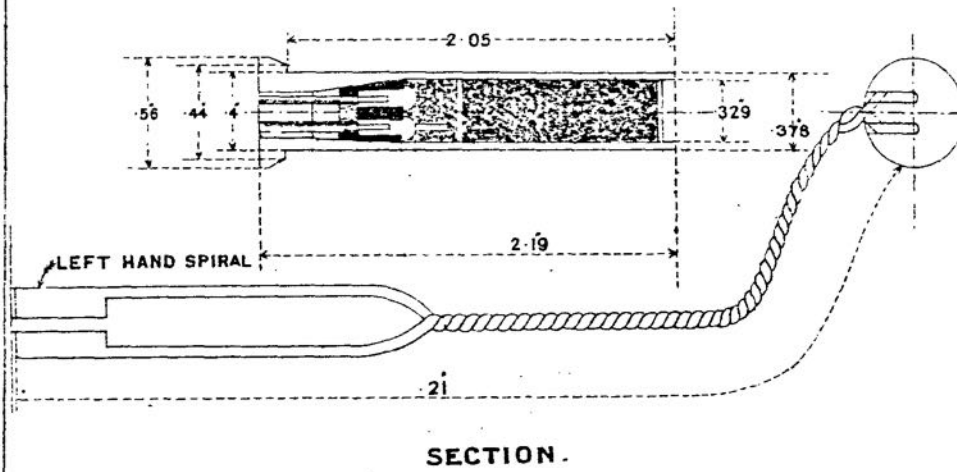
SILK CLOTH $\frac{1}{4}$ CHARGE PRIMED WITH PRISM¹ BLACK.

Scale $\frac{1}{4}$.

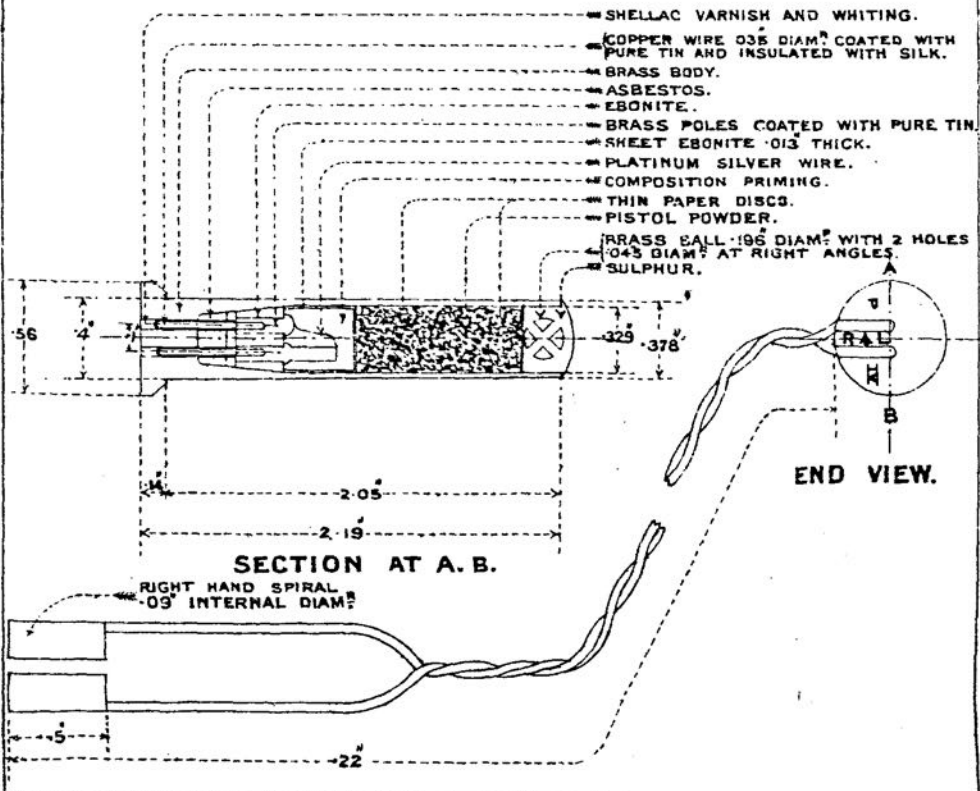


NOT TO EXCEED
PLAN.
WITH PART OF TOP DISC REMOVED.

TUBE VENT SEALING ELECTRIC MARK III.
BRASS FOR GUNS WITH PERCUSSION LOCKS.
FULL SIZE.



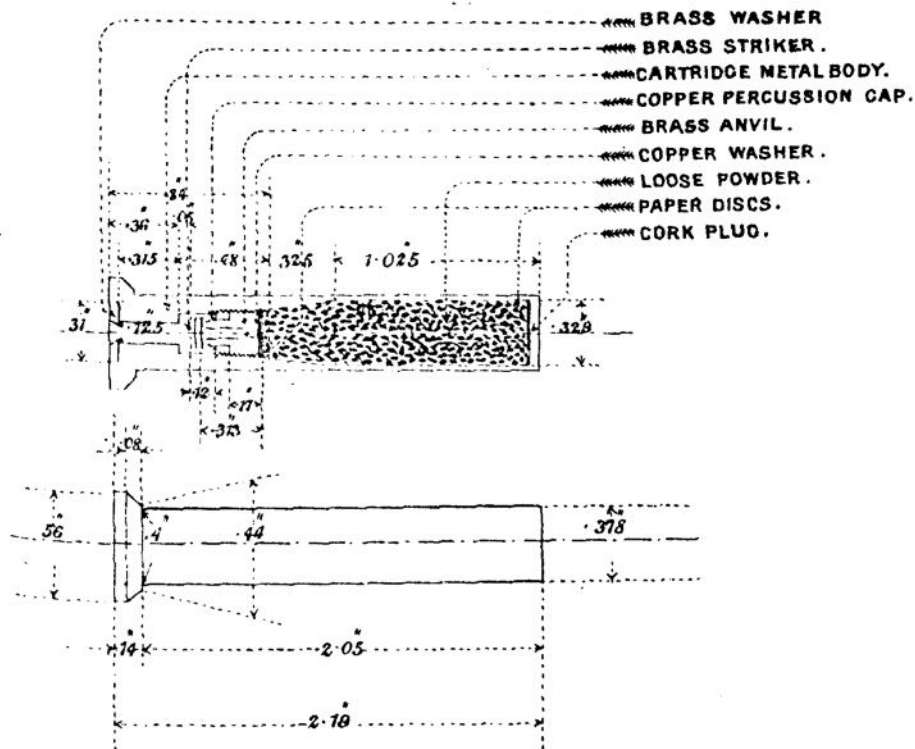
TUBE VENT SEALING ELECTRIC P MARK IV.
BRASS FOR GUN WITH PERCUSSION LOCK.
FULL SIZE.



TUBE VENT SEALING PERCUSSION MARK II.

BRASS, FOR GUNS WITH PERCUSSION LOCKS.

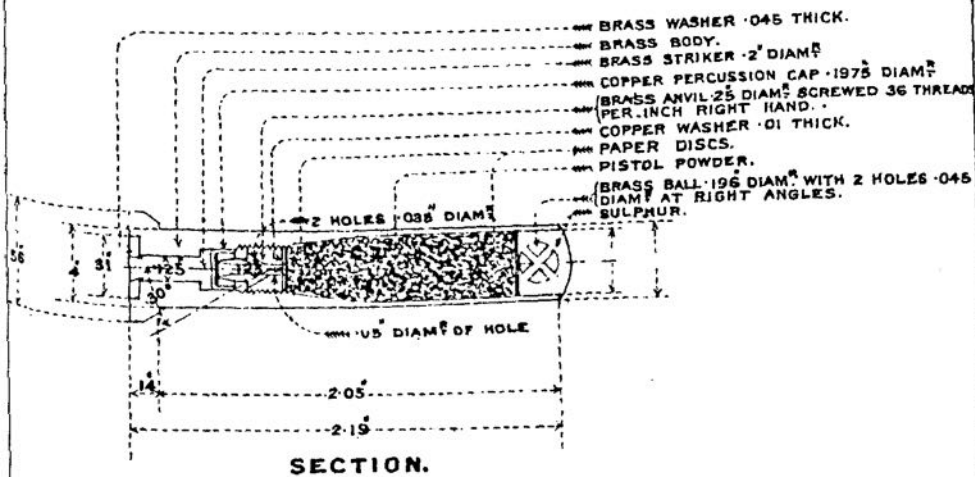
Full Size.



TUBE VENT SEALING PERCUSSION MARK III.

BRASS FOR GUNS WITH PERCUSSION LOCKS.

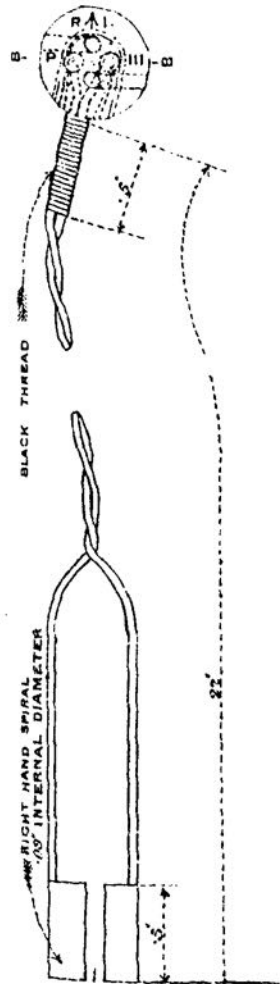
FULL SIZE.



TUBE VENT-SEALING ELECTRIC P DRILL MARK III.

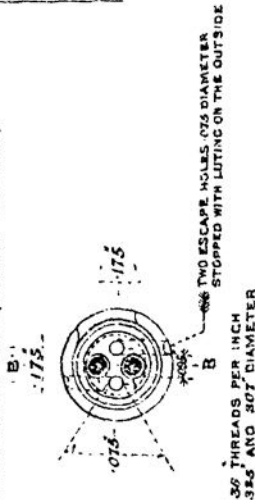
GUNMETAL, FOR GUNS WITH PERCUSSION LOCKS.

FULL SIZE.



END ELEVATION.

COPPER WIRE .005 DIAM. COATED ALL OVER WITH PURE TIN
INSULATED WITH SILK AND TWISTED
GUNMETAL
EMCITE CYLINDER INSIDE DIAM. .03
COMPOSITION PRIMING
PLATINUM SILVER WIRE (21 GRAIN PER YARD)



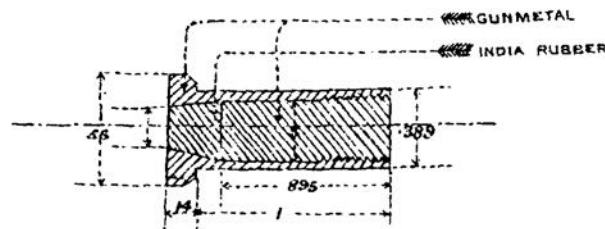
SECTION AT A.A.

SECTION AT B.B.

TUBES VENT-SEALING PERCUSSION DRILL (MARK I.)

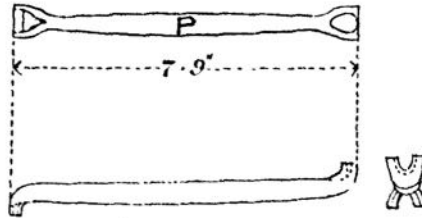
GUNMETAL FOR GUNS WITH PERCUSSION LOCKS.

FULL SIZE



EXTRACTORS.

EXTRACTOR TUBE P (MARK I.) STEEL VENT SEALING PERCUSSION.



EXTRACTOR TUBE P SPECIAL (MARK I.) STEEL VENT SEALING, PERCUSSION.

SCALE 1/4.

SECTION THRO' A.B.

